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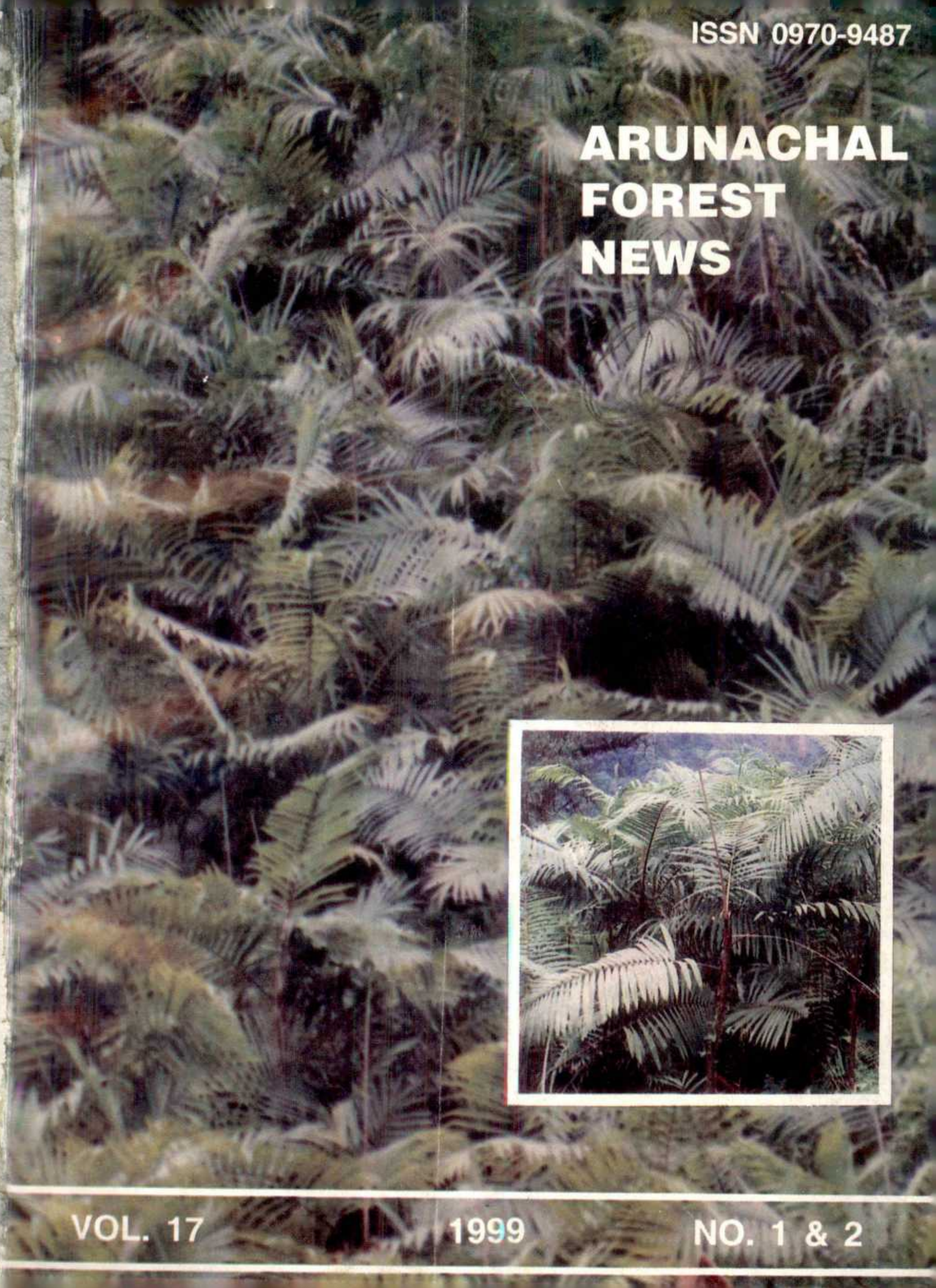

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Front cover : A view of the cane plantation in a village in Siang District.

Back cover : 15 years old bonsum trees.

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PHOEBE GOALPARENSIS (BONSUM): A POTENTIAL SPECIES FOR SOIL AMELIORATION

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ABSTRACT

The influence of *Phoebe goalparensis* (Bonsum) on soil properties was studied in a 15 year old plantation stand. Soil properties such as moisture content, bulk density, water holding capacity, permeability, void ratio, pH, organic carbon, available nitrogen, phosphorus and potassium contents, microbial population and biomass and enzyme activities were improved under tree cover over the control (no tree cover).

INTRODUCTION

Phoebe goalparensis (Bonsum) belongs to the family Lauraceae and is an endemic species of North Eastern States of India. It's a large tree butressed at the base, bark is grey, reticulately furrowed, leaves are lanceolate or ovate lanceolate, flowers are in lax panicles, fruit are ellipsoid and blackish. The species is shade bearer. Artificial reproduction is done by seedlings raised in shaded beds in the nursery. Transplanting may be done in June when the seedlings are eight months old and 23 cm high in between the lines of *Tephrosia candida*. Winter transplanting of Bonsum seedlings of 1.2 m height (branches and leaves pruned off) may be done under the cover of *Lagerstroemia speciosa*. Stump planting also gives encouraging results however, direct sowing of seeds has been found unfavourable. Bonsum is susceptible to a number of diseases such as mottled spongy rot (*Ganoderma applanatum*), brownish rot (*Polyporus gilvus*), white spongy rot (*Tremetes corrugata*) and white fibrous rot (*T. serpens*). This species yields excellent light-weight timber and constitutes one of the most valuable timbers of Assam known as "Bonsum" in trade. It is also popularly known as Assam Teak. The wood of Bonsum is moderately durable and used for house construction, door and window frames, veneers, plywood, packing cases, cabinet making, interior fittings of railway coaches, furniture, general joinery and in air craft construction (The Wealth of India Vol. VIII, 1970).

Natural forests and man made protected plantations contribute a lot of organic material to the soil in the form of leaves, twigs, stems, flowers and fruits, which after decomposition result in the formation of organic matter and release of plant nutrients (Prichett and Fischer, 1987; Saikh *et al.* 1998). The nature and amount of organic matter produced after decomposition of the litter depends on the dominating tree species present and site characteristics of the area which regulate the physico-chemical properties of soil (Chavan *et al.*, 1995). Different forest species are known to exert varied influence on soil properties (Singh and Suri, 1987 ; Chavan *et al.*, 1995).

An evaluation of soil properties under different tree covers is an important area of research to understand the impact of trees on soil as the soil properties change considerably as a result of tree planting (Hosur and Dasog, 1995). Keeping this in view and considering little research work done in this area, the present study was undertaken with an aim to know the influence of *P. goalparensis* on physico-chemical, biological and biochemical characteristics of soil.

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MATERIALS AND METHODS

Study site, climate vegetation and soil :

The study site used in the present investigation was 15 years old *P. goalparensis* plantation (see back cover) which lies within the Banderdewa Forest Division of Arunachal Pradesh, India. The study site is located at 27°6' N latitude and 93°49'E longitude at an elevation of 200 m above sea level.

The climate is humid tropical. The study site receives mean annual rainfall of 1850 mm of which about 80 percent is received during March to September. The mean ambient temperature is 18.2°C. The natural vegetation of study area comprises mainly of forest tree species namely, *Bombax ceiba, Altingia excelsa, Duabanga grandiflora, Gmelina arborea, Ailanthus grandis, Chukrasia tabularis, Terminalia myriocarpa, Toona ciliata, Canarium strictum, Dillenia indica, Kydia glabrescens, Anthocephalus chinense* and *Phoebe goalparensis*. Patches of Bamboos, Banana and *Imperata cylindrica* are also seen.

Geologically, the study area consists of sedimentary (sandstones) rocks and is mainly drained by Dikrong River. The soil is dark brown/brownish black in colour and sandy loam in texture (and 86-92%, silt 7-11% and clay 1-3%).

History of land use and Sampling procedure :

The study site before the regeneration with Bonsum plantation was covered with natural forests of local species and Bamboos. The traditional practice of shifting cultivation (Jhum) and other developmental activities brought about deforestation and converted the forests into degraded lands. Before planting Bonsum, the study site was clear felled for the artificial regeneration. The clear felling of natural forests was followed by the burning of forest and its debris and thereafter the seedlings of Bonsum were planted in pits. The control area was also under natural forest cover before 15 years which was also clear felled and debris were burnt before using the land for jhum cultivation. The area was used for the cultivation purpose for few years and then it was left as a fallow land. The control site has been lying as a fallow land adjacent to a plantation area for the last ten years infested by *Lantana camara* and *Dryopteris* species.

Soil samples were collected from both Bonsum plantation and control sites. Fifteen soil samples (0-15 cm soil depth) were collected from each plantation and control site. Three samples were collected from beneath the canopy of five trees of Bonsum selected randomly. In control site, the samples were collected randomly from fifteen places. Biological and biochemical properties of soil were estimated by using fresh soil. However, the physico-chemical properties were determined with the help of air dried and sieved (<2 m) soil samples (Okalebo *et al.*,1993).

The moisture content was determined by the Gravimetric method which involves collection and weighing the moist sample, removing the water by oven drying at 105° C for 48 hours and weighing the dry samples. The surface soil of about 1-2 cm was removed before collecting the soil samples for the determination of bulky density. The soil samples were collected by inserting a metallic cylinder of known diameter and height to a depth of about 5 cm. The excess soil from the samples was removed with a knife. The moist soil from the sampler was kept in a hot air oven for drying at 105°C for 48 hours. The bulky density of the soil samples were calculated by dividing the dry weight of soil samples with the volume of sampler. In case of void ratio a known quantity of soil was poured into a measuring cylinder upto a certain volume level (Vs). Thereafter, water was poured with the help of another measuring cylinder to make the soil 100% saturated. The amount of water added

(Vw) was noted and void ratio was calulated by dividing the Vw with Vs. Water holding capacity of the soil samples was determined with the help of Ken's box apparatus. The soil permeability was recorded by constant head method using Jodhpur (India) Permeameter. Soil texture analysis was done with the help of soil hydrometer.

Soil pH was determined with the help of an electric pH meter in a 1 : 5 soil water suspension. Organic carbon of soil samples was determined by Weakly and Black's (1934) rapid titration method. Soil phosphorus was determined with the help of molybdenum blue method. Estimation of ammonium and nitrate nitrogen was done with the help of indo phenol blue method. Potassium content was determined with the help of digital flame photometer.

Fungal population was estimated by soil plate method using rose bengal agar medium (Martin, 1950). Bacterial population was determined with the help of dilution plate method using nutrient agar medium (Johnson and Curl, 1972). Soil microbial biomass was estimated with the help of chloroform fumigation technique Okalebo *et al.* (1993). Dehydrogenase activity was measured with the help of Casida (1977) TTC reduction technique. Urease activity was measured with the help of McGarity and Myers (1967).

RESULTS AND DISCUSSION

The results on influence of Bonsum plantation on physico-chemical characteristics of soil have been depicted in table 1. The soil of study site is sandy loam in texture. The soil of control site (without tree cover) had more silt and clay content than the silt and clay contents of soils under Bonsum tree cover. Absence of tree cover, generally, decreased the organic matter content in soil. Loss of organic matter causes soil aggregates to be crushed and consequently the finer particles translocated along with soil (Hajabbasi *et al.* 1997). The moisture content of the soils under plantation and control sites varied from 16.75% to 17.57% (table 1). The highest moisture content was recorded from the soil under *P. goalparensis*. Bonsum has a dense and evergreen canopy, which reduces the evaporation of moisture under the direct influence of solar radiation.

The bulk density of the soil samples under Bonsum tree cover and control ranged from 0.77 g cm^{-3} to 1.40g cm^{-3}. The soil of control site showed maximum bulk density. This may be due to the absence of tree roots which has resulted in the compactness of soil. According to Seubert *et al.* (1977) and Allen (1985), soil compaction commonly results in a decline in macroporocity, higher susceptibility to erosion, and decreased hydraulic conductivity. The presence of roots and organic matter content in voids might be responsible for the lower values of bulk density under Bonsum tree cover. The results of present study are in conformity with other workers (Chavan *et al.*, 1995 ; Hajabbasi *et al.*, 1997). Soil void ratio didn't vary much between control and Bonsum plantation. The void ratio directly influenced the water holding capacity of soil. In the present study too, void ratio showed the direct relationship with the water holding capacity (table 1). The water holding capacity of soil under *P. goalparensis* was 57.28%. The permeability of soil exhibited wide variations between the tree cover and control (table 1). This could be due to the presence of less and small pore spaces and compactness of the soil under control site. The premeability was inversely related to bulk density. In case of *P. goalparensis* increased filtration rate is attributed to the bulk lower density of soil.

The influence of *P. goalparensis* on chemical characteristics of soil has been depicted in table 1. The pH of soil under tree cover and control varied between 4.2 and 6.3. The control site soil showed a low pH value of 4.2 as compared to Bonsum plantation site. The reduction in soil pH under control site might be due to the formation of weak acids in soil.(Vadiraj and Rudrappa, 1990 ; Nandi *et al.* 1991). Increase in soil pH under tree cover might be due to the addition of leaf litter, which is rich in nitrogenous and other mineral substances. Organic carbon was more under the soil of *P. goalparensis* than the soil of control site. The control site had organic carbon 0.14% while it was 1.12% under the cover of *P. goalparensis.* Higher organic carbon under *P. goalparensis* plantation might be due to the higher input of litters to the soil by this species. The available ammonium nitrogen varied from 0.45 to 0.53 mg 100g^{-1} between *P. goalparensis* plantation and control site soils. The available nitrate nitrogen varied from 0.40 to 0.68 mg 100g^{-1} between control and *P. goalparensis* plantation site soils. The nitrate nitrogen content was higher in case of *P. goalparensis* over control. Enhanced microbal mineralization of organic matter universally augments the available nitrogen ($NH4^{+}$ and $NO3^{-}$) in soil (Mukherjee *et al.*, 1991). The available phosphorus content in control soil was higher than the available phosphorus in *P. goalparensis* soil (table 1). The changes in available soil potassium content was in correspondence with the changes in available phosphorus content of soil (table 1).

The data on influence of *P. goalparensis* on soil microbial population and enzyme activities have been given in table 2. Fungal population was higher under the soil of *P. goalparensis* tree cover over control. Tree cover had a profound influence on the fungal population (Griffiths *et al.* 1997). Bacterial population was also higher in soil of *P. goalparensis* as compared to the soil of cotrol.

Table 1. Physico-chemical characteristics of soil under *Phoebe goalparensis* plantation and control sites.

Soil properties	*Phoebe goalparensis* plantation site	Control site without tree cover
Moisture content (%)	17.57	16.75
Bullk density (g cm^{-3})	0.77	1.40
Water holding capacity (%)	57.28	46.91
Permeability (10^{-4} cm Sec^{-1})	3.50	1.30
Void ratio	0.49	0.43
pH	6.3	4.2
organic carbon (%)	1.12	0.14
Available nitrogen NH_4^+—N mg 100 g^{-1}	0.45	0.53
Available nitroigen NO_3^-—N mg 100 g^{-1}	0.68	0.40
Available phosphorus (P_2O_5 mg 100 g^{-1}	1.70	1.93
Available potassium (K_2O mg 100 g^{-1}	11.9	13.51

Values presented in the table are means of 15 replicate samples.

Table 2. Biological and biochemical characteristics of soil under *Phoebe goalparensis* plantation and control sites.

Soil properties	*Phoebe goalparensis* plantation site	Control site without tree cover
Fungal population (No. g^{-1} dry soil x 10^{3})	5.16	2.97
Bacterial population (No. g^{-1} dry soil x 10^{3})	0.59	0.23
Microbial biomass C (mg g^{-1} dry soil)	1.13	0.11
Dehydrogenase activity (mg TPF g^{-1} dry soil $24h^{-1}$)	0.8	0.4
Urease activity (mg NH_4^+-Ng^{-1} dry soil 3^{-1})	0.18	0.09

Values presented in the table are means of 15 replicate samples.

Higher bacterial population under the soil of tree cover might be due to the higher organic carbon content of soil (Tiwari *et al.*, 1987). The microbial biomass carbon content of the soils under the control and tree cover ranged from 0.11 to 1.13 mg g^{-1} dry soil respectively. Higher microbial biomass carbon of soil under tree cover might be due to the higher litter input and higher moisture availability in soil of plantation area over control. The minimum values of above mentioned factors in the soil of control site might be responsible for the lower values of microbial biomass carbon at this site. The activity of dehydrogenase enzyme ranged from 0.4 to 0.8 mg TPF g^{-1} dry soil 24 h^{-1} in the soils of control and *P. goalparensis* respectively. *P. goalparensis* showed the higher value of dehydrogenase enzyme activity as compared to control. The urease enzyme activety in soils under control and *P. goalparensis* ranged from 0.09 to 0.18 mg NH_4^+Ng^{-1} dry soil 3 h^{-1} respectively. The control site had a lower value of urease activity than *P. goalparensis* . Lower values of organic carbon in control site (table 1) might be responsible for the lower urease activity in the soil of this site. Pancholy and Rice (1973) also found that urease activity was related to the type of vegetation and quality of organic matter incorporated in the soil. Tiwari and Mishra (1995) noted higher dehydrogenase and urease activities from forest soils as compared to the grassland soils.

The results of the present study revealed that the Characteristics of soil are improved much under a tree cover over control. *P. goalparensis* showed a better influence on soil physico-chemical, biological and biochemical properties. The soil of control site showed least changes in soil properties in the absence of tree cover.

CONCLUSION

The results of the present study clearly indicate that the continued maintenance of *P. goalparensis* plantation has influenced the important soil properties such as bulk density, premeability, water holding capacity void ratio, pH, organic carbon, available nitrate nitrogen, microbial population and biomass and enzyme activities favourably in comparison to control. This shows that the Bonsum plantation has resulted in grater improvement in soil properties over control. It amy be inferred that *P. goalparensis* plantation has little or no adverse effect on soil properties and demonstrate the amelioration of soil properties under *P. goalparensis* plantation.

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ETHNOBOTANY, ITS SCOPE IN ARUNACHAL PRADESH

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ABSTRACT

Arunachal Pradesh, the largest state of North East India covering an area of 83743 sq.km. has been identified as one of the biodiversity 'Hotspot' areas in the world (Myers, 1988). It has a very rich floral and faunal diversity due to its variation of altitude ranging from 150 mtr to 6500 mtr. and climatic condition. The original inhabitants of Arunachal Pradesh are tribal people (Schedule tribe), belonging to 20 major tribes and 110 sub tribes. The major tribes are 1. Monpa, 2. Serdukpen, 3. Aka, 4. Miji, 5. Bangnis, 6. Nyishi, 7. Apatani, 8. Bangrus, 9. Solungs, 10. Tagin, 11. Adi, 12. Mishmi, 13. Hill Miri, 14. Khampti, 15. Wangcho 16. Nocte, 17. Tangsa, 18. Singpho, 19. Memba and 20. Khamba. Every tribe has its own dialect with minor differences within subtribes. According to 1991 census, the total population of Arunachal Pradesh is 8,64,558 (Male-4,64,004, Female-3,99,554) and out of these 5,50,351 belong to schedule tribe. These tribal people have their own culture, tradition and medicinal system of treatment with a practical and applied aspect of knowledge acquired through close observation of nature. So, they are a store house of indigenous knowledge which is yet to be explored and recorded. Only a little information and books have been published on ethnobotanical knowledge of some tribes, like Monpa, Nyishi, Apatani, Adi and Idu-Mishmis. But, no proper and thorough study has been made till now.

INTRODUCTION

Ethnobotany is a study about the plant wealth used in our day to day life as medicine, food, vegetable, fuel, fodder, furniture, ornament and worship, cultural materials, preferably by the aboriginal and tribal people. The word ethnobotany was first suggested by Dr. John Harshberger of the University of Pennsylvania in an address to the University Archeological Association on 4th December, 1895 to describe the study of plants used by primitive and aboriginal people and was widely accepted and first time adopted by J. Walter Fewnes in 1896. Ethnobotany has been recognised as a multidisciplinary study comprising many interesting and needful aspects of plant science, history, anthropology, culture and literature. The study of ethnobotany gives us an idea of relationship between man and plants, socio-cultural relationship with their surrounding natural environment and their faith, taboos, worship and several other magico-religious aspects. According to S.K. Jain and R. Mitra (1997), the wide horizons of ethnobotany are primarily three ; firstly, the origin and soul of this subject are in primary basic human needs, in tradition and in faith, things, which are immortal and infinite. Secondly, the body and substance of this science are in plant resources – plants which sustain all life on this earth, and are a renewable resource. Thirdly, and most significantly, the subject has close historical implications with our past, relation with so many facets of our present thought, responses, needs and actions and relexance also with our future welfare and environments like needs of new foods and medicines and conservation of genetic diversity of ecosystems.

The subject ethnobotany is divided into many sub disciplines according to sub-groups of plant kingdom, like, ethnoalgology, ethnomycology, ethnobryology, ethnopteridology, ethnolichenology, etc. and special aspects of botany, like classification systems, medicinal uses, palaeobotany, ecology etc. are termed as ethnotaxonomy, ethnomedico botany, palaeoethnobotany and ethnoecology respectively. Now a days the subject is emerging under specialized titles like ethnopharmacology, ethnomedicine, ethnogynaecology, ethnopaediatrics, ethnoagriculture, ethnobiology, ethnomusicology, etc. and separate journals have been published on some of these subjects.

DISCUSSION

Arunachal Pradesh has a very rich flora containing 4500 species of Angiosperm, including 600 species of orchids, 450 species of medicinal plants, 52 species of Rhododendron, 18 species of Hedychium, 16 species of Oaks, 45 species of bamboo, 20 species of cane and 35 species of Gymnosperms. It is a mountainous state and the forest type also different according to the altitude. The main forest types which seen in the state are 1) Tropical semievergreen 2) Tropical wet evergreen 3) Sub tropical forests 4) Pine forest, 5) Temperate forests and 6) Alpine forests. These forests contain many rare and endangered plants like *Coptis teeta, Panax pseudoginseng, Aconitum ferox, Podophyllum hexandrum, Amentotaxus assamicus, Tetracentron sinense, Rhododendron arunachalensis, R. tawangensis, R. dalhousie, Gymnocladus assamicus, Dendrocalamus sahni, Hypericum griffithii, Lithocarpus kamengensis, Pinus merkusii, Kayea assamica* etc. The orchids which contain beautiful and pleasant flowers like *Arundina graminifolia, Paphiopedilum fairrienum, P. venustum, P. spicerianum, Dendrobium densiflorum, D. aphylla, Cymbidium ensifolium, C. grandiflorum, Phaius tankervilicae, Rhynchostylis retusa, Vanda coerulea, Gymnadaenia orchidis* are available in the state. Besides these, the forests are full of many valuable trees like *Terminalia myriocarpa, Terminalia belirica, T. chebula, Dipterocarpus macrocarpus, Shorea assamica, Mesua ferrea, Morus laevigata, Duabanga grandiflora, Altingia excelsa, Bombax ceiba, Phoebe goalparensis, Canarium strictum, Artocarpus chaplasha, A. lakoocha, Bischofia javanica, Acrocarpus fraxinifolius, Dillenia indica, Sapium baccatum, Cinnamomum cecicodaphne, C. zeylanicum, Pterygota alata, syzygium spps., Albizia spps., Castanopsis spp., Quercus spp., Michelia champaca, Pinus merkusii*, etc.

The tribal people of Arunachal Pradesh completely depend upon these forest plants starting from their festival to agricultural works. They use many plants in their day to day works. Table I. gives a common and brief idea of the ethnobotany of the people of Arunachal Pradesh. From the study on the ethnobotany of Nyishi tribe of Papumpare district, it is found that, they use 86 plants as medicine, 66 species as vegetable, 55 as edible, 6 for beverage and local drink, 25 species plants as timber, 5 as spice, 16 plants for making furniture, 5 for roofing, 12 for making cultural materials, 20 as fuel, 23 as fodder, 11 as ritual/magico religious belief, 12 as mythological and folklore, 10 for making ornaments and 18 for miscellaneous purposes. The study on only one tribe gives a convincing idea that, the tribal people of Arunachal Pradesh have a vast knowledge and practical experience about their natural surroundings and plant wealth.

Table I
Usage of Plants for different purposes.

Sl. No.	Purposes	Plants/Plant Group
1.	Medicine	*Coptis teeta, Aconitum ferox, Podophyllum hexandrum, Panax pseudoginseng, Acorus calamus, Adhatoda zeylanica, Andrographis paniculata, Ageratum conyzoides, Berberis aristata, Bergenia spp., Crassocephalum crepidioides, Costus speciosus, Clerodendrum colebrookianum, Solanum khasianum, Solanum torvum, Urena lobata, Houttuynia cordata, Musa spp. etc.*
2.	Beverage/drink	*Eleusine coracana, Oryza sativa, Zea mays, Saurauia roxburghii etc.*
3.	Timber	*Terminalia myriocarpa, Morus laevigata, Michelia champaca, Phoebe goalparensis, Tectona grandis, Dipterocarpus macrocarpus, Pinus wallichiana, P. roxburghii, P. merkusii, Quercus rex, Gmelina arborea, Duabanga grandiflora etc.*
4.	Spice	*Illicium griffithii, Cinnamomum tamala, Allium sativum, Houttuynia cordata, Mentha arvensis, Zingiber officinale etc.*
5.	Furniture	*All Canes (Rattans), Bambusa tulda, B. pallida, Morus laevigata, Michelia champaca, Terminalia myriocarpa, Duabanga grandiflora, Tectona grandis, Pinus wallichiana, P. roxburghii Phoebe goalparensis, Dalbergia sissoo etc.*
6.	Vegetable	*Clerodendrum colebrookianum, Zanthoxylum oxyphyllum, Z. armatum, Polygonum posumba, P.perfoliatum, Pogostemon benghalensis, Solanum torvum, S.nigrum, S. tuberosum, Colocasia spps. Atylosia goensis, Artemisia indica, Chenopodium album, Amaranthus caudatus, A. viridis, Diplazium esculentum, Sarchochl-amys pulcherrima, Spondias pinnata, Eryngium foetidum etc.*
7.	Edible	*Antidesma acuminata, Artocarpus heterophyllus, Baccaurea sapida, Morus indica, Mangifera sylvatica, M.indica,Polygonum auriculata. All fruits of canes(rattans), Areca catechu, Garcinia cowa, G. pedunculata, Ziziphus mauritiana, Elaeocarpus floribundus, All Citrus sps. Terminalia citrina,Dillenia indica, Madhuca butyraceoides etc.*
8.	Food	*Oryza sativa (2-3 sps.), Zea mays,Solanum tuberosum. Ipomoea batatas, Eleusine coracana, Cyathea gigantea etc.*
9.	Roofing	*Imperata cylindrica, Livistona jenkinsiana, Saccharum sponteneum, Themeda villosa, Phyllostachys assamicus etc.*
10.	Cultural materials	*Calamus tenuis, C. flagellum, C. floribundus, C.erectus,C.leptospadix. Daemonorops jenkinsiana, Bambusa tulda, B. pallida, Pinus wallichiana, P. roxburghii etc. and other timber species.*

11.	Fuel	*Generally all dry trees and bamboos, tall grasses etc.*
12.	Fodder	*Leaves of all bamboos, grasses, leaves of Bauhinia purpurea, Eleusine coracana, Ficus dumosa, F.hispida, Themeda villosa,all species of Musa, Saccharum, Thysanolaena, Carex, Oryza etc.*
13.	Ritual/folklore/ mythological	*Calamus sps (3-4 sps.) Quercus rex, Q.lamellosa, Arundina graminifolia, Elaeocarpus ganitrus, Rhododendron sps., Pinus sps., Tsuga sps, Phegopteris sps., Entada sps., etc.*
14.	Ornaments	*Calamus erectus, C. tenuis, C. leptospadix, Daemonorops jenkinsiana, Bamboosa tulda, B. pallida, Dendrocalamus hamiltonii, etc.*
15.	Detergent	*Sapindus mukorossi,Gymnocladus assamicus,Entada purseatha.*
16.	Decorative	*All orchids, Pinus sps., Cryptomeria japonica, Polyalthia pendula, Aurocaria sps., Ferns and other flowering plants.*
17.	Dye	*Rubia cordifolia, Acacia catechu, Areca catechu, Viburnun foetidum, Eclipta prostrata etc.*
18.	Broom	*Thysanolaena maxima. Sida rhombifolia.*

In Arunachal Pradesh ethnobotanical studies have been carried out only on a few tribes, but none of these tribes are studied in detail. The state is not completely explored botanically in the interior areas due to lack of communication. It was started by Burkil in 1924-25 when he studied the Botany of Abor hills (**Rec. Bot. Survey India** 10(1) 1-54, 1924, 10(2), 155-420, EI 1-10, 1925). Since then many scientists and researchers have worked on the flora, ethnobotany, ethnomedicines of Arunachal Pradesh so far. Yet, there is a vast ethnobotanical knowledge of the tribal people which has remained untouched, unstudied and unrecorded.

CONCLUSION

Study on the ethnobotany of Arunachal Pradesh gives an idea on the indigenous knowledge of medicinal plants, used in treatment of diseases like dysentery, fever, brain, blood pressure, urinary trouble, cancer, food poisoning etc. Natural/herbal drugs can be extracted from such plants for proper chemical analysis. Many wonder drugs discovered during the last fifty years indicate that these are still untouched plants and animal wealth of unknown medicinal value employed in tribal medicine. Number of edible fruits and vegetables used by the ethnic communities could be considered as substitute of foods and vegetables with proper conservation and cultivation measures. For example, the Lisus of Gandhigram area, conserve the 'Tree fern' (*Cyathea gigantea*) to be used during femine and grain shortage. The pith of tree fern is used as food and it is believed, at the time of need it gives more yield. So, a wild indigenous germplasm of such important medicinal, edible and economic plants could be established to achieve the socio economic and industrial development of the tribal areas without changing their food habits. In addition to these, the ornamental and decorative orchids could be grown for commercial purpose which has a good market and economic value. Of course, it is praiseworthy step that, some people of the state already have started cultivation of orchids on commercial basis and have been earning a good profit. Some of craft items, for manufacturing cultural items and furniture, using bamboo and cane could gear up to establish a good market in the country, while these items are becoming very popular not only in India but also in other countries with proper value addition. This would improve the standard and quality of life in the state and solve the unwanted unemployment problem.

So, there is a need to gear up documenting process of vast knowledge of ethnobotany of the tribal peoples of Arunachal Pradesh scientifically and conserve the plants for a better future of the human society of the world.

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ETHNOMYCOLOGY OF SOME LOCAL TRIBES OF ARUNACHAL PRADESH

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ABSTRACT

This paper gives a brief account of the mushrooms in the Hill-Miri tribe of Arunachal Pradesh. The various means of identification, local names, taboos, recipes and local methods of treating mushroom poisoning have been discussed.

INTRODUCTION

Arunachal Pradesh is the largest state in Northeastern region of the country. The total area of the state is 83,743 sq. km. out of which 81.90% area is still under forest cover (Anonymous, 1997). The wide ranging altitudinal variations (200 m to 5000 m), hilly physiography and a well distributed rainfall have resulted in about 20 district forest types which broadly fall into tropical semi-evergreen, tropical wet-evergreen, sub-tropical broad-leaved, temperate and alpine forests (Kaul and Haridasan, (1987).

There are 26 major tribes and a number of sub-tribes in the state. Most of these communities are ethnically similar but their geographical isolation from each other has brought amongst them certain distinctive characteristics in language, dress and customs (Singh, 1999). The people live in close harmony with nature. The routine of the local people is to go every day in the forests for jhum cultivation and at the same time they also collect fuel-wood, as well as different food items (leaves, fruits, rhizomes, mushrooms, medicines etc.) from the surrounding forest area to fulfil their day to day need. Due to their close association with nature, people are well familiar with mushrooms and have their own means and ways to identify them. An effort has been made in this study to explore the different methods of identification of edible and poisonous mushrooms, local taboos and values attached with it in the Nyishi (Hill Miri) tribe of Arunachal Pradesh.

The local name of mushroom in Nyishi tribe is *Ende*. The different criteria which are used to identify a poisonous or edible species are mentioned below :

1. Poisonous species

The poisonous mushrooms are called *Auy Hatar* (*Auy* means ghost). Some common characteristics of poisonous mushrooms are :

i. Red and black colour of the fruit bodies;
ii. Mushrooms with hollow stem are generally treated as poisonous, and
iii. Fruit-bodies spongy at the base of stem.

Species having white coloured fruit-bodies are identified on the basis of points No. ii and iii.

2. **Edible species**

   i. Upper surface of the cap white or yellow ; hymenium (lower surface of the fruit-body) brownish to black;
   ii. Fruit bodies with solid stem, and
   iii. Stem base not spongy.

CLASSIFICATION ON THE BASIS OF HABIT AND HABITAT

These mushrooms can be divided into two groups viz. terricolous and lignicolous on the basis of their habit and habitat

i. **Terricolous species**

Fruit-bodies occur over soil, dung, etc. They are further sub-divided into following categories.

a. ***Ende*** : Fruit-body stipitate ; usually large in size ; occurs single or sometimes in a group of 1 or 2 ; white to brown in colour ; stem solid i.e. not hollow ; quite deep inside the ground and very sharp at the base which is called hebu chuku dinla (sharp).

b. ***Ende Dayak*** : Fruit-bodies occur in clusters, and

c. ***Ambuk (Buluk)*** : Cap whitish-brown, small and round, stem very thin just like a match stick.

ii. **Lignicolous species**

Fruit-bodies occur on logs, stumps, tree trunks etc. they are further sub-divided into following groups on the basis of different characteristics of their fruit-bodies.

a. ***Imbuk*** : Fruit-body with a distinct stripe, usually white ;

b. ***Hatur*** : Fruit-body without gills ; white to pinkish ; stem very short or absent. It is edible as long as fruit-bodies are soft in texture.

c. ***Subre*** : Fruit-body without stem, occurs in clusters, 1 cm long or less, and

d. ***Ingur*** : Cap large, 8 to 10 cm ; soft whitish-brown in colour, occurs in clusters, rarely single.

MUSHROOMS AND LOCAL TABOOS

It is a general belief that mushrooms occurring on the fecal material of certain animals such as tiger, deer, elephants, etc. are edible while fruit-bodies collected from the fecal material of other animals such as squirrels, rats, etc. are discarded. They are generally identified by the colour and texture of the fruit bodies. The local people also know the fact that some mushrooms-cause vomiting and dehydration only but no life is harmed.

In ancient times there used to be war amongst the villages. If a person from an enemy village collects and eats the mushroom from the territory of the other village, the person used to suffer from vomiting and dehydration and there were chances of death also. There is a belief that this happened due to some kind of magic or prayer invoked by the priest of other village. To avoid this poisoning there was a ritual called *Auy* and the affected person was to be saved by a ceremony called "**Khenyik dapa auy mobo lo aldo**". After observing this ceremony, the person could eat any of the edible mushrooms from the territory of the other village.

A list of the fungi which were identified form different parts of the state is given in Table 1.

Some of the edible species which are sold in the Naharlagun market are *Auricularia auricula, Pleurotus spp. Schizophyllum commune*, etc.

RECIPES

The mushrooms or *Ende* is collected from the forest and after washing properly it is boiled with dried bamboo shoots called *Huyup* or *Hichur* (local language). It is often prepared with the chicken or with the fresh meat of wild or domesticated animals. Sometimes it is dried over the fire or in sunlight and then it can be eaten after boiling with the ingredients of bamboo shoots.

TREATMENT OF MUSHROOM POISONING

Generally the tribal people are aware of the mushrooms which are poisonous and non-poisonous and to avoid any mishap they strictly follow the criteria for their identification. The local belief is that mushroom-poisoning occurs by eating those mushrooms which has been influenced by *Auy* (Spirits). It causes vomiting, stomach-ache, diarrhea, etc. which is then cured by performing a rituals called, "**Khenyik Peya**". The priest has to spell mantras and sacrifice hen or other domesticated animals in order to please the spirit (*Auy*). After observing this ceremony the affected person becomes alright. However, the victims of deadly poisonous mushrooms cannot be treated by these rituals and eating them may result into the death of the person or whole of the families.

PRECAUTIONS

Mushroom poisoning may also occur due to the collection of over mature and decomposed fruit-bodies which are generally infested by insects or other fungi. These should be avoided. Before cooking, the fruit-bodies should be cleaned thoroughly with water before cooking and heavy quantity of new-mushrooms and consumption of alcoholic drinks should be avoided while eating them.

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Table 1. List of the fungi collected from different parts of Arunachal Pradesh.

Sl. No.	Species	Status
1.	Antrodiella minutipora	Non-edible
2.	Auricularia auricul	Edible
3.	Cantharllus cibarius	Edible
4.	Daldinia concentrica	Non-edible
5.	Earliella scabrosa	Non-edible
6.	Flavodon flavus	Non-edible
7.	Fomitopsis carneus	Non-edible
8.	Ganoderma applanetum	Non-edible
9.	G. lucidum	Non-edible
10.	Hericium ernaceus	Edible
11.	Heterobasidion insulare	Non-edible
12.	Hexagonia tenuis	Non-edible
13.	Irpex consors	Non-edible
14.	Laetiporus suphurus	Edible
15.	Lenzites acuta	Non-edible
16.	L. betulina	Non-edible
17.	L. elegans	Non-edible
18.	Microporus affinis	Non-edible
19.	M. xanthopus	Non-edible
20.	Nigrofomes melanoporus	Non-edible
21.	Phellinus gilvus	Non-edible
22.	Phyllporia fruitica	Non-edible
23.	Polyporus arcularius	Non-edible
24.	P. sanguineus	Non-edible
25.	P. grammocephalus	Non-edible
26.	Pseudotrametes gibbosa	Non-edible
27.	Schizophyllum commune	Edible
28.	Sparassis crispa	Edible
29.	Spongipellis borealis	Non-edible
30.	Trametes hirsuta	Non-edible
31.	T. lactinea	Non-edible
32.	T. menziesi	Non-edible
33.	T. versicolor	Non-edible
34.	Trichaptum biformae	Non-edible
35.	T. byssogenum	Non-edible

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TOURISM IMPORTANCE OF ORCHIDS IN ARUNACHAL PRADESH

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ABSTRACT

Arunachal Pradesh is considered to be the 'nature's treasure trove' and home to orchids, known for their exquisitely beautiful blooms, form one of the dominant taxa with more than six hundred species, occurring in varying elevations and climatic conditions throughout the state. This particular gift of nature offers great opportunity to promote 'nature tourism' in Arunachal Pradesh. This article provides a glimpse of the wonderful world of orchids that have adorned the forests making this state an 'orchid paradise' of our country. Further, while presenting the diversity of habit and habitat of orchids, the efforts made by the department of Environment and Forests in establishing the Orchid Research Centre at Tippi and the Orchid Sanctuary at Sessa in promoting 'nature tourism' have been highlighted. In order to attract tourism, establishment of orchid cut flowers production centres, promotion of botanic gardens, and by supporting production of handicrafts and imitation jewelry etc., based on orchids can be taken up for developing eco-tourism in the state.

INTRODUCTION

Of late, tourism has gained tremendous importance world over and has grown into an industry of considerable economic importance. With the advancement of communication technology, transport system, well laid road, rails and aviation system, tourism has become an attractive enterprise facilitating the people to visit the far flung areas and distant continents anywhere in the world. The craze and desire of the people to see and enjoy the distant dream lands, locations, pilgrim centres and nature's marvels has infact given rise to the present day tourism which is an industry of multi -billion dollar world over. There are different kinds of tourism to meet the needs of various tourists as per their taste and requirements. Amongst them, "nature tourism" has gained tremendous popularity of the urban folk world over. Arunachal Pradesh, which is considered to be the "nature's treasure trove", has a great potential in promoting nature tourism and orchids have a greater role to play as far as Arunachal Pradesh is concerned.

Orchids – A nature's gift

Arunachal Pradesh situated in the extreme North East corner of India is indeed an enchanting land with rich, varied and colorful flora and fauna. The lush green forests spread over numerous hills rising from about 100m MSL to a height of about 7000 m encamped with eternal snow and criss-crossed by numerous rivers, provide congenial environment to myriads of life-forms that coexist harmoniously. A striking feature of the enormous vegetation that one finds here are lovely orchids, which bloom in profusion with myriads of colours and forms, a truly wonderful gift of mother nature.

Orchids are highly evolved group of plants occupying a top position in the plant kingdom as the human beings do in animal kingdom. They have a diverse habit, bizarre and curious flower structure with brilliant colours adding beauty to the land and the landscape. The very fact that there are about 20000 species distributed all over the world speaks of their diversity and varied nature having a realm of their own.

In India, there are about 1150 species distributed in various states. However, Arunachal Pradesh alone accounts for 601 species – almost 52% of the total species known in India, thus making Arunachal an "**Orchid Paradise**" of our country. Many of these species are rare, endangered, and ornamental. Because of their curious shape, brilliant colour and long-lasting quality of flowers, orchids are considered as '**gems**' in the field of floriculture. Orchids are infact proud possessions of the hobbyists, sought after by the nurserymen and are a symbol of royalty in many countries. The tourists with special crave for orchids would love to visit the natural habitat of the orchids, which could be commercially exploited (Hegde 1984, 1994).

In Arunachal Pradesh, orchids are a part and parcel of tribal life and culture. The orchids like *Dendrobium hookerianum* (Lishang Momdang), *D.nobile (Bomzang momdang)* and *D. gibsonii* are normally cultivated in Gompas symbolising the sanctity of the place and their use for holy worship. Similarly *Vanda coerulea* (Blue Vanda), popularly known as "Rangpu" by Wanchu tribals of Tirap district is invariably associated with their festival dances for decoration, similar to that of *Rhynchostylis retusa* – "Kopu-phul" used in Assam. A few of them are also used in traditional system of medicine, e.g. tubers of *Satyrium nepalense* as aphrodisiac and tonic, leaves and stems of *Cleisostoma williamsonii* for bone fractures, seeds of *Dendrobium nobile* for stopping bleeding from freshly cutwounds, etc. Interestingly, the fibrous pseudostem of *Dendrobium moschatum* is also used in basketry (Hegde, 1984).

Habit and Habitat :

Orchids have diverse habit with variously modified vegetative and floral structures, form and colour with varying requirements of light, shade, temperature and nutrition within a particular environment. They may be either saprophytes (leaf less orchids, growing on decaying organic matter), leafy terrestrials (growing on ground), ephiphytes (growing on tree trunks) or lithophytes (growing on rocks). However, these are essentially herbaceous- either single stemmed (monopodial) or many stemmed cluster (sympodial). All of them need humidity in atmosphere in varying percentage and mycorrhiza as their associate. They occur in various forest types ; from tropical valleys in the foothills to sub-tropical, temperate and alpine areas in varying concentrations. However, maximum number of species of orchids occurs in sub-tropical humid forests and with only a few in temperate and alpine forests.

One who treks through the jungles of Arunachal with watchful eyes, would unmistakably discover the "World of Paradise" of orchids.

Orchid Diversity – At a glance :

In the orchid family, there are members with primitive in character and fashion on the one hand and with tremendous specialization, modification, adaptation, fanciful and catching the eyes with brilliant colours and shapes, on the other. Hence, the entire orchid family with about 601 species in Arunachal Pradesh has been classified into six-sub-families, 17 tribes, 24 sub-tribes and 111 genera. Of these 148 species in 52 genera are terrestrials including saprophytes and 377 species in 61 genera are epiphytes including lithophytes. Amongst them Apostasias are considered as most primitive with least specialization, while *Vandaceous* orchids are highly evolved and advanced in nature.

There are about a hundred species of orchids, which are ornamental and commercially important; while nearly 175 orchid species are rare and endangered. Some of them are botanical curiosities. Interestingly as many as 30 species are endemic in Arunachal Pradesh and some of them have been recently discovered and are new to botanical science.

Saprophytes :

Some orchids grow on decaying organic matters on the forest floor having no leaves and without chlorophyll, but produce variously colored flowers. While passing through the thickets of these forests, one may find strikingly white coloured mushroom – like bodies about 1½′ tall group of plants – the *Epipogium* and *Stereosandra* species, dull-brown coloured *Gastrodia* species and *Eulophia zollingeri*, the giant 1-2 m tall golden yellow flowering spikes of *Galeola* species, etc. that thrill the onlooker. However these enigmatic plants cannot thrive under cultivation. There are 16 such saprophytic species recorded so far in Arunachal Pradesh.

Terrestrials :

The leafy orchids that grow on the ground in humus rich soil are terrestrials. There are about 132 species of leafy terrestrials known in Arunachal Pradesh. Some of the ornamental genera are *Acanthephippium, Arundina, Anoectochilus, Calanthe, Phaius, Paphiopedilum* etc. Amongst them, *Arundina graminifolia*, the "bamboo orchid", is normally seen grown in the open sunny areas amongst grassy patches in the foothills. These plants look like reeds and produce attractive flowers in light pink with deep purple lip.

In the thickets of the forest floor occur *Anoectochilus* and *Geodorum*, popularly referred to as the "**Jewel orchids**" group having beautifully designed velvety leaves. They are rare in occurrence however. *Acanthephiplum* species on the other hand, grow under heavy shades of trees on the ground or rocks and have curiously saccate yellow tinged purple flowers found in tropical and sub-tropical wet-humid forests. Similarly, the species of *Phaius* with comparatively larger and attractive flowers in yellow, pink and brown shades are found in these forests. There are about 14 species of *Calanthe* found in various forest types. They are one of the best known orchids under cultivation too. One of the species i.e. *Calanthe masuca* has the distinction of having been used in the first ever hybrid orchid produced in the year 1856 in London and is also found in tropical and sub-tropical forests of Arunachal Pradesh.

One of the rare, endangered, curious and sought after ground orchids found in Arunachal is the *Paphiopedilum* species (the Venus or Lady's slipper orchids). There are three species of the genus found in Arunachal, viz.; 1) *P.fairrieanum* popularly referred to as "Lost Lady's Slipper orchids", (2) *P. venustum* and (3) *P. spicerianum*. The first one occurs only in some patches in high hills above 1500 m MSL in sub-tropical to temperate mixed pine oak forests ; while as the other two species are found in tropical to sub-tropical forests only. All these species fall under the schedule VI, of the Wildlife (Protection) Act of India because of their rare occurrence and endangered status.

Epiphytes :

Majority of the orchids grows on tree trunks and are called epiphytes. They are either pendulous, erect growing, sympodial or monopodial, but always having aerial roots. In Arunachal Pradesh, there are 377 species in 61 genera recorded so far. Major genera amongst them are *Aerides, Arachnis, Bulbophyllum, Coelogyne, Dendrobium, Cymbidium, Eria, Cleisostoma, Rhynchostylis, Vanda* etc. Most of the epiphytic orchids are ornamentals.

In the tropical valleys of Arunachal Pradesh, one finds cascades of colorful flower-spikes of *Rhynchostylis retusa, Aerides odorata, A. williamsii, A. rosea, Cymbidium pendulum, C. aloifolium, Dendrobium aphylla, D. nobile, D. moschatum, D. fimbriatum* etc. loaded on tree trunks during spring time which add beauty to the surrounding wood. Some orchids like; *Cymbidium ensifolium, Aerides odoratum* etc. fill the air with pleasant aroma during the season. As one travels through the sub-tropical hill forests, bunches of "pineapple-orchids" the *Dendrobium densiflorum, D. pendulum, D. chrysanthem, D. hookerianum, D. devonianum,* varieties of rare *Cymbidiums* like, *longifolium, giganteum, grandiflorum, eburnium, mastersii, Vanda coerulea, Renanthera imschootiana* (red Vanda), *Coelogyne* etc. greet the on lookers. The mosscovered rocks present lovely blooms of various hues of Pleiones – the "*Indian crocusses*". The pink flowers of *Anthogonium gracile* on the cut ends of rocks and edges carpet the exposed areas adding beauty to the landscape.

It is however, significant to note that most of the epiphytic orchids are endangered in the wild as their very existence depends upon the trees, which are being exploited for various needs of man. Two epiphytic species viz. *Vanda coerulea* and *Renanthera imschootiana* fall under the Schedule – VI of Wild Life Conservation Act of Government of India and therefore trade of these species is restricted. Arunachal Pradesh is thus a "treasure house" of many a rare and ornamental orchids.

Orchid Research Centre Tipi :

Realising the importance of orchids, Govt. of Arunachal Pradesh has established Orchid Research Centre at Tipi on way to Bomdila in West Kameng District to promote orchid conservation, research and development. Over the past 27 years, the centre has been developed as a centre of excellence and a place of tourist attraction with central orchidarium containing number of exotic species and hybrids (Hegde, 1998). Some hybrids for commercial utilisation have been developed from the wild orchids of the state, by the centre. There are number of orchid houses, natural orchidarium and botanic garden with curious and rare orchids like *Paphiopedilum venustum, P. spicerianum, Vanda coerulea, Coelogyne, Renanthera imschootiana* etc. The idyllic location surrounded by lush green forests with rising hills transversed by the River Kameng makes the centre a paradise and tourist spot worth visiting for educational and tourism purposes. The centre also has a unique herbarium and museum depicting the various orchids of Arunachal Pradesh and neighbouring states. In addition, large number of orchid hybrids produced by the centre are on display and for sale. Indeed, any tourist would have a thrilling and satisfying visit to this centre. The Pakhui Wild life Sanctuary across the river Kameng is an added attraction.

Sessa Orchid Sanctuary :

In an effort to conserve the natural habitat of large number of orchid species, an area of 100 sq.km has been declared as "Sessa Orchid Sanctuary" at Sessa, West Kameng district, about 20 km away from Tipi. This is a wonderful location i.e. situated between 900 to 3100m MSL encompassing tropical, sub-tropical, and temperate climatic conditions and vegetation. Such a diverse physiography favors the occurrence of more than 200 orchid species with 5 new and endemic species, with in this area. The department of Environment & Forests has developed trekking routes for going through the sanctuary for visitors to enjoy the marvelous habitat of orchids in their pristine glory. There are deep gorges and valleys, high peaks and rugged terrain that make the trip of adventure tourists, as well of a the nature lover, exciting. (Hegde, 1995).

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Similarly, there are other orchid centres at Dirrang, Itanagar, Jengging and Roing which cover wide ranging habitat and diverse species of orchids. The development of farmer's orchid nurseries at Bomdila, Dirrang, Hapoli and Yazali areas have further widened the scope of floriculture related tourism activities in the state. Holding of 'Festival of Flowers' in various seasons at different elevation in Arunachal Pradesh would be an added attraction to the visiting tourists in different seasons.

Promotion of orchid related tourism activities :

Orchid flowers have attracted the people world over for their curious shape, colour and texture. To make use of these qualities, there is a vast scope for developing allied and subsidiary industries in addition to floriculture. No doubt, cut-flower production in the farm is the first and foremost economic activity that can be developed in Arunachal Pradesh. However from tourism point of view, there is a potential for developing Jewelry imitating orchid flowers, carpets with the picture of orchids, bamboo and cane articles depicting the ornamental orchid flowers, moulding of paper weight, glasses etc. with orchid flowers which could be used by the traders for sale as momentos to the tourists. Further, there are orchid flowers that give scent (e.g. *Satyrium nepalense, Aerides odoratum, and Cymbidium munronianum*) which could be extracted and sold. In order to make various tourist spots in Arunachal Pradesh attractive, botanic gardens should be developed with special emphasis on orchid, which happens to be the "**State Flower**" in Arunachal Pradesh.

Hence, in order to develop tourism with special emphasis on orchids, such infrastructure is needed to be created without causing damage to our wild grown species and their habitat. It is of paramount importance that the tour operators are advised suitably to develop eco friendly packages for orchid tourists and trekkers so that they don't damage the habitat during the course of their visit. In fact, in USA alone, there are more than 500 Orchid Societies and large number of enthusiasts who would like to visit the world's orchid rich habitats and "biodiversity hot spot', such as Arunachal Pradesh. It is worthy to mention here that the modern day orchid hybrids of commerce have been derived from the species of this region by contributing the useful germplasm, especially of *Cymbidium, Paphiopedilum and Vanda.* Therefore, it is obvious that the advanced countries would like to have our unique germplasm. Thus while venturing upon specialised orchid tourism it must be ensured that we don't lose our wild and unique germplasm, through illegal collection and trade, but this unique germplasm is conserved and used only as tourist attraction, in its natural form and habitat.

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ORCHIDS AND MYCORRHIZA : AN AMAZING SYMBIOTIC ASSOCIATION

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ABSTRACT

Orchidaceae is one of the most interesting plant family having diverse habit and distribution in wide ranging habitat. In nature, orchids are associated with mycorrhiza in the roots in a symbiotic manner. Their seeds are minute and have reduced or no endosperm. They germinate in association with a specific fungus which helps in nutrient uptake and becomes a partner in some part of their life cycle or throughout. This paper briefly deals with orchid mycorrhiza, symbiotic germination and orchid-fungus relationships.

INTRODUCTION

Orchids are one of the most amazing groups of plants belonging to the family Orchidaceae. This family contains more than 2000 species, second only to the Asteraceae. In fact, no plant family is more diverse than this family be it, size, shape, form, cormophytic body (aerial roots, pseudobulbs etc.), flower, habit, habitat, pollination mechanism or distribution.

Two other important remarkable characters of orchids are: firstly, their seeds are extremely small (the largest is about 14 mg) and with differentiated embryo; secondly, they all have mycorrhizal associations, living throughout or at some point of their life. Although the term "mycorrhiza" (coined by Albert Bernhardt Frank around 1855) would seem to imply the association of fungi with roots, relationships called "mycorrhizal associations" are found between hyphal fungi and the organs of higher plants of whatever morphological origin, which are concerned with absorption of nutrients from the soil. Orchids have established a mutual beneficial relationship with specific fungi – called "Symbiotic Association", which is indeed amazing. Thus orchids are benefited more than any other plants with this mycorrhizal symbiotic association as elaborated below.

Mycorrhiza of orchids :

Most of the mycorrhizal fungi associated with orchids belong to the genus *Rhizoctonia.* These include *R. repens*, which was much used in the pioneer experiments of Noel Bernard, *R. goodyera-repentis* and *R. solani* (a very active parasite of herbaceous plants). The other species are *Corticium, Thanetophorus, Ceratobasidium, Ypsilosidium, Coriolus, Fomes, Arunillaria, Marasmius, Xerotus, Hymenochaetae, Sebacina, Tulasnella* etc. some of which are renamed from Rhizoctonia after their perfect stages were obtained.

mbiotic germination :

As described earlier, orchid seeds are reduced. minute and contain negligible reserved food t also in the form of starch and lipids or devoid of them. In nature large number of seeds go waste hout being able to germinate. Therefore the orchid seed germination, in the early 19th century, were y much studied for two reasons, one for their floricultural and horticultural importance, the other for simple reason that they are hard or impossible to germinate. In earlier times, mycorrhiza were sumed to be parasites and cause disease. By 1800 AD, contrary to the belief, it was found that the nts get benefited from these fungal associations. Notable among workers in orchid germination are el Bernard (1874-1911) who isolated many endophytic mycorrhiza and germinated many orchid ds symbiotically and Hans Burgeff (1883-1976) an expert in mycorrhiza, who studied, isolated and empted to classify the mycorrhiza. The latter had also succeeded in symbiotic germination of orchids failed asymbiotically.

During germination an orchid seed takes up water and swells. Swelling is followed by the et of metabolic activity, including the disappearance of lipid reserves and the formation of starch (if seed is viable), bursting of the testa and production of a few epidermal hairs. At this stage, the bryonic cells may contain number of starch grains which are hydrolysed very slowly, but do not port the growth of the protocorm, which may eventually die. If per chance a suitable mycorrhizal gus is present at the site of germinating seed, single fungal hyphae penetrates the wall of either the dermal hair or epidermal cells near the suspensor (basal) of the embryo. The fungus then loses its racter and spreads its mycelium on the lower lying basal (suspensor) cells of the seedling, using its ch. It begins storage, and the storage hyphae undergo digestion, thereby promoting the development protocorms and further differentiation into seedlings. Hairs like papillae developed on the seedlings generally the fungal mycelium, which grow through them from inside out. The terminating growing nt (apical meristem) produces leaf primordia, which grow into first leaflets. Later, the first root ears. Thus, a mutual supportive and beneficial relationship is established between the growing orchid nt and the mycorrhizal fungus, which in case last throughout the length of their life.

Symbiotic germination was successfully practiced by many workers in the early part of the last tury with root isolates. Many other workers developed different methods. They used different nutrient r mediums or substrates of polypodium, moss etc.. Infection was done simultaneously or at a later ge. However, there are many constraints in symbiotic germination of orchid seeds. The fungal strain d should be specific for the orchid and the association should be perfect i.e., there should be digestion he fungus without being killed or lost or *vice versa.*

chid-fungus relationship :

In this unique relationship between orchid and fungi the orchid plant sits on the fungal net like orophore and receives glycogen, protein and fat, growth substance and also phosphate, potash and er important substances from the entire net, which it dominates. Studies on culture of mycorrhizal gus shows that glutamine, glutamic acid, aspartic acid and small quantities of other amino acids are duced (but not released into the medium). Some orchids are unable to synthesize an adequate unt of glutamic acid and that in nature it might depend on symbiotic fungi for such supplies. Some dentified *Rhizoctonia* was also reported to produce niacin, only vitamin to show enhancement of nination. It would seem therefore, the nutrient requirements of orchids cannot be provided completely and efficiently by an external supply of nutrients (Hadley 1982). The symbiotic theory of nutrition argues that mycorrhizal fungi break down complex carbohydrates, absorb the hydrolysates together with other nutrients, and transport them into the tissue. It has already been reported that orchid fungi decompose cellulose and their mycelia translocate fungal sugar trehalose, carbon and phosphorous compounds across a diffusion barrier into the protocorms. These are some of the examples where orchids get benefited from fungal associations.

Fungi, like higher plants, need mineral elements for their nutrition. In addition, fungi need carbon sources owing to their lack of chlorophyll and ability to assimilate carbon dioxide. The main carbon sources are sugars which the fungus can freely convert or access it from various insoluble compounds by means of its enzymes. Nitrogen is taken up in inorganic form or organic such as proteins, peptones, amino acids etc. Nucleic acid is the best nitrogen source. They can not assimilate free nitrogen from the air. Fungi are also supposed to get carbohydrates or carbon from the orchid plant but it is difficult to prove.

It is now a well established fact that in nature orchids cannot survive without mycorrhizal fungal association. Nowadays, in artificial propagation of orchids, symbiotic germination is no longer in practice. Lewis Knudson (1884-1958) in 1922 got the first breakthrough in asymbiotic germination of orchids creating a revolution for artificial germination of orchids using nutrient agar medium containing sucrose. However, orchid fungus can be utilized for growth of *in vitro* cultured Protocorm-like-bodies and hardening of seedlings and plantlets in a useful way, thereby reducing the cost of production and maintenance. We are still to learn from orchids which establish good relationship with various living beings at different stages of their life i.e. with fungus at the time of germination, and with insects, the main pollinating vector for fertilization, in a very intelligent manner, and thus to lead a harmonious life in nature. Amazing indeed.

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RATTANS - THE PRICKLY PALMS

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ABSTRACT

Rattans (canes), the beautiful prickly climbing palms can be used as decorative plants. Here, their ornamental value has been described.

INTRODUCTION

Rattans, more popularly known as canes in our country are prickly climbing palms. World over, there are 13 genera and 600 species. (Uhl & Dransfield, 1987, Renuka 1992). They are largely confined to the tropics mostly in south and south east Asia, America and Africa. Malaysia, Indonesia, Philippines, are the most important Rattan producing countries. India too has one of the richest germplasm of rattans in the world. These are represented by 5 genera viz. *Calamus*, *Daemonorops*, *Plectocomia*, *Korthalsia* and *Zalacca*. However for all purpose *Calamus* is the most important genus. Altogether there are about 60 species of which *Calamus* alone has 46 species, *Daemonorops* 6 species, *Plectocomia* 4 species, *Korthalsia* 2 species and *Zalacca* has 1 species. The distribution of rattans in the country is characteristic with three major zones of distribution which are – 1) Western ghats (27 species) 2) Andaman and Nicobar Islands (19 species) and 3) North east India (26 + species). Jati, Lejai, Raidang, Houka and Sundi are some of the popular ones in the north east region. By and large they are shade loving plants found in the tropical forests. Some of them can tolerate exposure to sun and grow in open. They are also indicative of wetness. Few like *C. tenuis* (Jati) can withstand inundated conditions as well.

UTILITY

Canes are known for their importance as raw material for furniture which are gaining increased popularity all over the world and are a craze for the urban people. Apart from their furniture utility they have other advantages. The leaves of some species are used as thatch for roofing. Fruits of some species are edible. Young shoots of certain species are also used as vegetable. More over a large number of these species are ideal as garden plants. (Haridasan 1997, Thomas et al 1998).

RATTANS AS ORNAMENTALS

They can be used as pot plants for indoors and as grooves and boughs in large gardens. Except a few seedlings, all species are attractive with their fan/feather shaped leaves, which have differently arranged leaflets. If properly watered they do not need much care as they are comparatively free from pests and diseases. As a word of caution it may be mentioned that since there are thorns on leaves and plant body, they should be kept away from the reach of children to avoid pricking and injury. The seedlings are very easy to grow from seeds. Properly maintained cane seedlings can substitute costly exotic palms. They are bound to add beauty to your drawing rooms. Not only that, their beautiful leaves are good for bouquets and floral arrangement.

CONSERVATION

By growing cane seedlings you are not only adding to the aesthetics but also helping their conservation.. It's a way of helping preservation of germplasm and survival of one of the endangered groups of plants as they are in peril in their wild habitats.

So next time when you see a cane seedling take second look and try to nurture it.

CARING CANE IS CARING NATURE !

Rattans of Arunachal Pradesh

Sl. No.	Name of species	Local name
1.	Calamus leptospadixLejai	Lejai
2.	C. tenuis	Jati
3.	C. floribundus	Lejai
4.	C. flagellum	Raidang
5.	C. erectus	Jenk
6.	C. acanthospathus	Jati
7.	C. gracilis	Chuli
8.	C. inermis	Takat
9.	C. nambariensis	Hooka
10.	C. latifolius	Takat/Hooka
11.	C. khasianus	Takat
12.	Daemonorops jenkinsianus	Raidang
13.	Plectocomia himalayana	Dorrey
14.	P. bractealis	Pani beth
15.	P. assamica	Hati beth
16.	Zalacca secunda	Jenk

CONCLUSION

Rattans/canes are beautiful prickly climbing palms, distributed mainly in Western Ghats, Andaman and Nicorbar Islands and North eastern region in India. There are 5 genera and 60 species. Canes are utilised in many ways. Canes can be used as ornamental plants for indoors as well as gardens. This is a way of conservation of germplasm, as they are in peril in their wild habitats.

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GERMINATION BEHAVIOUR OF *CALAMUS FLAGELLUM* SEEDS

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ABSTRACT

Mature seeds of *Calamus flagellum* were utilized to study the germination behaviour in sand and soil under partial shade and complete shade conditions. There was no germination from the clean seeds (seeds after removing pericarp and sarcotesta) after treatments with 50% H_2SO_4 and 50% HNO for five minutes. Germination period was minimum (66 to 100 days) when clean seeds were sown on soil under partial shade conditions after soaking in clean cold water for 24 hours but maximum (125 to 144 days) when intact seeds were sown on sand under complete shade condition. The highest value of mean germination percents (92%) was observed from the clean seeds sown on sand under complete shade condition after soaking in 8% methanol for 24 hours. However, similar results (91%) were obtained from the clean seeds treated with clean cold water or 4% ethanol for 24 hours under same conditions. The lowest value (28%) of mean germination percents was found when intact seeds sown on soil under partial shade. Germination value was found highest (0.78) when clean seeds were sown on soil under partial shade after soaking in clean cold water for 24 hours. On the other hand, lowest germination value (0.0576) was observed from the intact seeds sown on soil under complete shade.

INTRODUCTION

Rattans are mostly trailing or climbing spiny palms with characteristic scaly fruits, classified under the subfamily Calamoidae (Dransfield & Uhl 1986) of the family Arecaceae (Palmae) and one of the most important non timber forest produce from North East India particularly Arunachal Pradesh. World wide, there are about 600 species of rattan belonging to 13 genera (Renuka 1992, Haridasan 1997) and are found only in the tropics largely confined to South East Asia, Africa and America. In India till recently 60 species are recognised (Basu 1992, Renuka 1997) out of which Arunachal Pradesh has 18 species (Thomas et al. 1998).

Calamus flagellum locally known as 'Raidang' is one of the most commercially important rattan species from North East India. This species is harvested for cane, making furniture, handicraft and also has ethnobotanical utility. Due to the heavy extraction of rattans for furniture industry from natural forest, there is an urgent need to cultivate the species having commercial potentiality. This study was initiated to establish proper germination technique for cultivation.

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MATERIALS AND METHODS

Mature seeds of *Calamus flagellum* were collected from the tropical forests of Arunachal Pradesh and were utilized for germination experiments. Seeds were sown at a depth of 3 cm in soil and sand in large trays and kept in partial shade (with overhead shade only) and complete shade under net house (covered all round). Six different treatments were applied and five replica for each treatment were taken before sowing the seeds. Twenty seeds were utilized for each replication. Regular watering was done to provide sufficient moisture for seed germination. Germination period, mean germination percentage and germination value which is an index combining speed and completeness of germination were recorded. The germination value of rattan seeds was calculated as per the method prescribed by Czabator (1962). Germination value is a product of peak value of germination and mean daily germination.

RESULTS AND DISCUSSION

Germination of rattan seeds fits a type of germination known as adjacent ligular (Dransfield 1997). The seed consists of a hard endosperm which has a small and cylindric embryo on one side. During germination, the embryo swells out through a germination pore, pushing out the thin tissue covering the pore (pore cover) and forming a 'plug' of tissue out side the pore which is connected by a narrow stalk to the haustorial cotyledons within the endosperm. The radicle emerged from the centre of the plug about one week after the pore cover had fallen off. Following this an irregular swelling emerged from one side of the plug and from this swelling the shoot emerged out which is a small, bladeless structure. The first leaf which bears a blade is usually the next foliar organ to emerge.

In this study a seed was said to have germinated when the bladeless shoot emerged out from the soil or sand.

The result obtained on germination parameters under various treatments are presented in Table 1. Only 28% to 37% of mean germination were observed in case of intact seeds, while 39 % to 42% were observed if outer scaly pericarp of the seeds were removed. These values are not related to the reported value by Mori *et al.* (1980) where they observed no germination in case of *Calamus manon* seeds. It is possible that the pericarp and sarcotesta may retard germination by the inhibition of gas exchange. Germination period was maximum and germination value was comparatively minimum in both the treatments than other treatments. There was no germination from the seeds when clean seeds were soaked in 50% H_2SO_4 or 50% HNO_3 for five minutes. Perhaps, this concentration of H_2SO_4 or HNO_3 might kill the embryo of the seed. An increased mean germination percent and germination value were observed when pericarp and sarcotesta were removed from the seeds and then soaked in clean cold water for 24 hours. Mean germination percentage (91%) and germination value (0.638) were found good when clean seeds were sown on sand under complete shade after 24 hours water soaking, but germination period (94 to 115 days) was comparatively more than 66 to 100 days when sown on soil under partial shade (exposed to sun for average 2 hrs.) under similar treatments.

Table 1 : Germination of seeds of *Calamus flagellum* under different treatment.

	Partial shade (with overhead shade)			**Complete shade (under net house)**		
Treatment	Germination period (days)	Mean germination (%)	Germination value	Germination period (days)	Mean germination (%)	Germination value
I. Germination test in soil						
A.	91 to 120	28	0.06	109 to 137	33	0.0576
B.	90 to 113	40	0.12	90 to 125	42	0.1128
C.	66 to 100	66	0.442	32 to 112	74	0.4424
D	-	-	-	-	-	-
E	-	-	-	-	-	-
F	76 to 101	89	0.78	85 to 116	86	0.5495
G	73 to 104	74	0.507	83 to 115	74	0.4224
II. Germination tests in sand.						
A	105 to 125	30	0.06	125 to 144	37	0.065
B	95 to 121	39	0.103	120 to 140	40	0.081
C	87 to 111	75	0.457	94 to 115	91	0.638
D	-	-	-	-	-	-
E	-	-	-	-	-	-
F	85 to 115	84	0.53	97 to 123	92	0.572
G	88 to 117	75	0.413	95 to 121	91	0.575

Treatment used :

A – Intact seeds with sarcotesta and pericarp were soaked in clean cold water for 24 hours.
B – After removal of the outer scaly percarp seeds were soaked in clean cold water for 24 hours.
C – After removal of the pericarp and sarcotesta (Clean seed) by rubbing with sand, seeds were soaked in clean cold water for 24 hours.
D – Clean seeds were soaked in 50% H_2SO_4 for 5 minutes.
E – Clean seeds were soaked in 50% HNO_3 for 5 minutes.
F – Clean seeds were soaked in 8% methanol for 24 hours.
G – Clean seeds were soaked in 0.5 % ethanol for 24 hours.

In terms of germination value, the best result (0.78) was obtained when seeds were sown on soil under partial shade after soaking in 0.8% methanol for 24 hours. However, mean germination percentage was slightly lower (89%) than the highest value (92%) where seeds were sown on sand under complete shade under the same treatment.

It was observed that clean seeds when soaked in 0.8 % methanol for 24 hours was very much effective when sown on soil under partial shade than 0.4 % ethanol treatment. On the other hand, similar results were found when clean seeds were sown on sand under complete shade after soaking in clean cold water, 8% methanol and 4% ethanol. It is possible that at that concentration, methanol may enhance the imbibation process by acting upon cell membrane of the seed. Germination period was found minimum when seeds were sown on soil under partial shade and maximum when sown on sand under complete shade. It was reported that seeds of *Calamus manon* germinated within 1-4 months (Naingallen 1985). The onset of germination of certain *Calamus* species was also reported to take more than four months and the germination percentage varied from 3-80% depending upon the species (Generalao, 1977).

CONCLUSION

The above results amply clarify that cane is better germinated in partial sunlight i.e. in areas where there is chance of getting exposed to sun for at least 2 hrs. This would mean, conventional shade beds with an over head shade above 1.5 meter as given in forest nurseries would enhance seed germination performance better than the modern net houses which considerably reduce sunlight penetration.

It is also significant to note that local traditional practices like removal of seed coat and seed testa along with soaking in cold water for about 24 hours are significant in germination and better nursery management. Other favourable treatments like soaking of seeds in low concentration of alcohol are easy to adopt and cost effective.

Thus, it may be seen that a little care while sowing can greatly enhance seed germination in case of *Calamus flagellum* and success in nursery establishment. This has also a bearing in conservation of canes as the entire group of canes in the present context are being threatened and needs conservation efforts. Our experiments also highlight the possibility of augmenting natural regeneration through slight manipulation of shade in forests by selectively removing some branches of shade plants and allowing penetration of sunlight. The study also points out for taking up further experiments on other aspects of seed germination and nursery technique.

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STATUS PAPER ON BAMBOO IN MIZORAM

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ABSTRACT

The forest rich state of Mizoram has approximately 57.8% bamboo covered area and has about 20 species in 9 genera of bamboos. The paper briefly mentions the bamboo-diversity, bamboo stock and production management problems, and particularly the gregarious flowering, increase in rodent population and its effect. The paper also peeps into the future scenario of bamboo in Mizoram and need for establishing a bamboo research Institute.

INTRODUCTION

Mizoram is a small state (21,081 Sq.km.). It is sandwiched between Myanmar and Bangladesh in the northeast India. The projected population in 2000 A.D. is 9,31,875 persons, the density being 44/ Sq.Km. The State enjoys tropical, sub-tropical and sub-temperate climates with high rainfall (2000 mm 3500mm) and high humidity (60-100%) per annum and the temperature varies from 9°C-32°C. Tribal concentration (94.8%) in Mizoram is highest (Anonymous 1996) in the country with highest literacy rate (95.5%) (Anonymous 1997), actual forest cover (89.1%) and bamboo covered area (57.8%) (Anonymous 1997b). The total area of the recorded protected and reserved forests account for 32.5%, whereas the existing protected area network (National Parks and Sanctuaries) constitute about 5% and the growing stock is 34 cub.m/h (tree) and number of bamboos is c.3465 culms/ha. (Anonymous 2000). The soil is generally young and fertile. The climatic condition favours the luxuriant growth of vegetation, particularly, bamboo.

BAMBOO DIVERSITY IN MIZORAM

Bamboo occurs throughout Mizoram. Out of 150 India's bamboo species, more than 58 species occur in northeast India, of which about 20 species in 9 genera have been reported from Mizoram (Annexure). Of these bamboos, *Melocanna baccifera* is pre-dominant. The species of *Dinocloa compactiflorus, Chimonobambusa callosa, Schizostachyum capitatum* and *Sinuarcendinaria intermedia* are found to be present above 1400′ MSL. The species like *Bambusa khasiana, B. tulda, Dendrocalamus spp., Schizostachyum dullooa, S. polymorphum* and *Melocanna baccifera* etc. are distributed in sub-tropical areas, whereas *Schizostachyum capitatum* var. *capitatum* and *Melocanna baccifera* occur in tropical riverine reserves and valleys. *Bambusa khasiana, Melocanna baccifera* and *Schizostachyum dullooa* show gregarious monopodial (non-clump) type, while all other species (except *Chimonobambusa callosa* in Blue Mountain) are sympodial (Clump) type. *Bambusa tulda* and *Dendrocalamus longispathus* usually inter-clump in some forest areas. It should be noted that *Bambusa vulgaris* and *Dendrocalamus strictus* are introduced species. Studies on bamboo in Mizoram were contributed by Fischer 1938 ; Forest Survey of India 1992, Lalramnghinglova 1995, 1997, 1999 and Jha 1999.

UTILILTY AND PRODUCTION

The past and present traditional uses include agricultural, baskets, caps, furniture, handicrafts, thatchings, working-sticks, water-vessels, conduits, guard-rails, fuelwood, live fences, fencing, house construction, flute, tying and weaving purposes, foodstuffs and medicine. Recently, bamboos are used for RCC beam and posts, laminated bamboo-ply and bamboo utensils. The commercial exploitation includes house construction, scaffolding, rafters, shutter-support and paper pulp etc.

According to Forest Survey of India 1992, the total bamboo stock in Mizoram was estimated to be 16,545.45 (000) MT while the annual yield was 3,237.689 (000) MT. Domestic consumption of bamboo was estimated as 28.315 (000) MT while surplus availability for industrial purpose was estimated at 3,209.379 (000) MT. Jha 1999 studied domestic consumption of bamboo shoots during July - August 1999 and estimated the weekly availability in the markets in the state as 2,91,436 numbers. According to the statistical record of the State Forest Department, a revenue of Rs. 53,25,680.00 was received from both bamboo permit and mahal systems during 1997-98.

MANAGEMENT PROBLEM

Dendrocalamus hamiltonii and *Melocanna baccifera* generally occur in gentle slopes, whereas other species occupy steep gradients and difficult accessibilities. The collection and transportation are highly cost intensive due to lack of good communication network systems in Mizoram. Shifting cultivation is the major problem of bamboo management in the state. The muli bamboos became first colonizers in many Jhumland areas with stunted growth behaviour. The periodic bamboo flowering time at 48 years cycle followed by mass death and starvation has been perhaps the most difficult problem in bamboo management. Two kinds of famines are recognised - "**Mautam**" famine and "**Thingtam**" famine. Mautam famine is caused by the flowering of *Melocanna baccifera* and that of Thingtam famine by *Bambusa tulda.* The last known thingtam famine occurred in 1785, 1833, 1881, 1929 and 1977 and that of Mautam famines in 1815, 1863, 1911 and 1959. The next Mautam famine is due to happen in 2007, inevitably. The preventive measures taken in 1959 and the preliminary guidelines formed in 1997 are as follows:

The preventive measures taken in the last Mautam famine (1959) are summarized as follows:

1. The government arranged food supply through road transportation air droppings and ferries and boats.
2. The government took great relief measures like gratuitous relief, relief work, subsidy, medical aid and facility, agricultural schemes and loans, famine relief vehicles and godown facilities.
3. The government also offered heavy price for killing of rats which was evidenced by production of the tails of rats.
4. Some neighbouring states donated cash payments towards the relief measures.

An important organisation called "Anti-Famine Campaign Organisation" (AFCO) formed in 1957 has laid down some guidelines, including -

1. Evolve techniques of precautionary measures against the periodic famine and other natural calamities.
2. Evolve scientific way of jhuming and intensive cultivation of cash crops.
3. Control of insect pests and other diseases against crop damage.

4. Preservation and conservation of land in a judicious way
5. Improve roads and communications.
6. Proper storage of surplus food-stuff

Dr. Barthakur, Science, Technology and Environment Cell, Planning Deptt. Govt. of India has suggested the following preventive measures:

1. Synchronization of bamboo flowers, mass collection of fruits and preservation of seeds as fodder.
2. Scientific experimental study of seeds, natural rodent control and phenomenal flowering of *Dendrocalamus* spp.
3. Introduction of economically important crops/plants supplementing famine food in large scale cultivation.
4. Paddy field surrounded by a pool of water so that the rodents can not cross over.

The State Level Committee on Rodent Control formed on 24th June 1997 has proposed the following precautionary measures to be taken up in view of the next Mautam famine to occur in 2007 A.D.

1. To invite Rodent specialist from the Govt. of India for early interaction with the Committee on Rodent Control.
2. To collect data and literature on bamboo flowering and fruiting from the various institutions of the country.
3. To encourage killing of rats with the help of indigenous traps like 'Mangkhawng' (Killing of rats by falling log), 'Thangchep' and 'Vaithang' (Noose-traps) right from now onwards.
4. To conserve tree seedlings in the jhum at the time of cultural operations.
5. Preparation of comprehensive schemes for funding towards research, rodenticide, awareness campaign, indigenous traps and prize for chasing and killing of rats.
6. Formation of District-Level Rodent Control Committee.

(Minutes of the Committee on Rodent Control (vide Memo No. 18015/5/97-DTE (Agr-PP) Dated Aizawl, the 26th .6.97 and 28.1.98.)

FUTURE SCENARIO

Cultivation management of bamboos has been under the active consideration of both the Central and State governments. The proposed national Bamboo and Rattan Research Institute and a project on Development of Bamboo Resources in Mizoram are being prepared. The State Industries Department has also prepared a project proposal for bamboo processing industries in collaboration with Taiwan Bamboo Institute. The taxonomic and *in-situ* and *ex-situ* conservation of bamboo resources are incorporated in the proposed State Forest Research Institute at Aizawl. The Institute of Rain & Moist Deciduous Forest Research (IRMDFR) Jorhat has been declared as Advance Study Centre of bamboo in North East India. The International Network for Bamboo and Rattan (INBAR) Beijing, China has developed bamboo technology a substitute for wood. The future scenario of national bamboo development rests upon the decision of the National Expert Team and the Action Plan to be drawn in their meeting held at Aizawl, March 2000. Establishment of National Institute of Bamboo and Rattan (NIBAR) at Aizawl was accepted in principle which will surely help in our efforts of conserving and utilisation of bamboo on a long term sustainable basis in the North Eastern part of India, where bamboo traditionally, culturally and economically is an inherent part of life.

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GROWING ORNAMENTAL PLANTS FOR HOUSEHOLD LANDSCAPING IN ARUNACHAL PRADESH

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ABSTRACT

This paper gives an insight into the variety of the species that can be selected for ornamental household landscaping in the state of Arunachal Pradesh. The species, planting time, commonly used propagation method and flowering period are given for each of the species that would help the house owner to decide the species that would appeal to his/her aesthetic sense in ornamental landscaping. A note on general method of growing potted plants and precautions to be taken for the maintenance of the same are also included.

INTRODUCTION

Man has lived in nature since the beginning of his existence and has developed love for beauty including love for flora and fauna of varied type. He found some of the plants useful from the point of aesthetic beauty for their attractive foliage, flowers and fruits and consequently started cultivating them for landscaping and beautification of households, parks, gardens, offices, temples, historical buildings and other ornamental structures. This cultivation has now reached commercial proportions. Some of the ornamental plants are being commercially cultivated in various parts of our country.

Arunachal Pradesh is a state rich in biodiversity and has varied climate from Alpine to Tropical. Due to such a huge variation in climate, a large number of plants grow naturally in the state. There are about 5000 species of plants which occur naturally in this area. The state is well known for its orchids and out of 1100 species of orchids existing in the country, about 525 species are found in the state (Hegde, 1984). Besides, due to varied climatic conditions, the state holds the potential for introduction of a number of ornamental plants. The household landscaping is picking up momentum in the state as more and more people are shifting towards permanent settlement and cultivation as compared to the past. The house landscaping requires proper choice of trees (tall, medium and small), small perennial foliage, flowering plants, hedges and annuals. If the space is sufficient, a provision of mini lawn can be made in each household. Proper sowing of annuals, planting and maintenance of plants is important (Yadav and Bose, 1989). The method of propagation of many tree species is as per the information available from Dwivedi (1992).

PLANTING TIME, FLOWERING PERIOD AND PROPAGATION METHODS OF DIFFERENT PLANTS :

The important grasses for lawns, perennials, shrubs and annuals are given below :

1. ORNAMENTAL BULBOUS AND CORM PLANTS

Name of Plant	**Planting time**	**Propagation method**	**Flowering Period**
Belladona Lily	February-March	Bulbs	May-September
Blue African Lily	February-March	Bulbs	May-September
Gladiolus	August-November	Cormet	November-March
Iris	September-October	Bulbs/Rhizome	February-April
Japanese Easter Lily	September-October	Bulbs	February-April
Spider Lily	February-March (Hills) September-October (plains)	Bulbs	May-September
Tiger Lily	February-March	Bulbs/scales/seeds	May September
Torch Lily	February-March	Bulbs	May-September
Tuberose	September-October	Bulbs	January-February

2. HOUSE PLANTS

A. Flooage Plants

Name of Plant	**Planting time**	**Propagation Method**
Acalypha	June-September	Cutting/layering
Alternanthera	June-September	Cutting
Arauacaria	February-August	Seeds
Asparagus	March-April	Cutting/seed
Azalea	February-July	Cutting
Chlorophytum	February-July	Stem cutting
Coleus	February-July	Stem cutting
Croton	February-July	Cutting/layering
Dieffenbachia	February-March	Stem Cutting
Dracaena	February-March	Stem Cutting
Maranta	March-April	Stem Cutting
Monstera	March-April	Cutting/layering
Mussaenda	February-July	Cutting and layering
Peperomia	February-March	Seed/Cutting
Rubber Plant	March-July	Cutting/layering
Scindapsus	February-March	Cutting
Thuja	December-March	Seed

B. Perennilal Flowering Plants

Name of Plant	Planting time	Propagation method	Flowering Period
Allamanda	February-July	Cutting/layering	May-September
Bottle Brush	February-July	Seed/layering/cutting	March-April
Bougainvillea	February-July	Cutting/layering	January-March
Chandni	February-September	Cutting	May-September
China rose	October-January	Cutting	December-February
Gazania	February-September	Cutting	December-February
Gerberas	February-September	Cutting	December-February
Harshringar	May-September	Seed/Cutting	June-September
Jasmine	May-September	Cutting	May-August
Kanchan	July-September	Cuttings/seed	July-September
Poinsettia spp	July-September	Cutting	May-September
Quisqualis	July-September	Cutting/layering	July-September
Rat Rani	May-August	Cutting	June-September
Rose	August-November	Cutting	December-February
Tecoma	May-August	Cutting/seed	January-March

3. HEDGES AND SHRUS

Name of Plant	Planting time	Propagation Method
Acalypha	May-September	Cutting/layering
Azalea	May-September	Cutting
Camellia	May-September	Cutting/Seed
Chandni	April-September	Cutting
China rose	October-January	Cutting
Clerodendron	April-September	Cutting
Duranta	March-September	Cutting
Hamelia	May-August	Cutting
Hydrangea	May-September	Cutting
Lawsonia	June-September	Cutting/Seed
Murraya	May-August	Cutting/Seed
Thuja	December-March	Seed

4. LAWN GRASSES

A. For Warmer Area

Name of Plant	Planting time	Propagation Method
Bermuda/Doob grass	March-October	Seed/runners
Korean Grass	April-August	Seed/runners

B. For Cooler area

Name of Plant	Planting time	Propagation Method
Bent or rec top grass	May-August	Seeds
Kentucky blue grass	May-August	Seeds
Rye grass	May-August	Seeds/Vegetative

5. LANDSCAPE PLANTS

Name of Plant	Planting time	Propagation method	Flowering Period
Amaltas	May-September	Seed	April-May
Arauacaria	February-August	Seeds	Foliage plant
Bottle Brush	February-July	Seed/layering/cutting	March-April
Champa	May-September	Seed	March-May
Flame of Forest	May-September	Seed	March-April
Gulmohar	May-September	Seed	September-October
Kanchan	July-september	Cutting/seed	July-September
Madar	May-September	Seed	April-May
Nahar	May-August	Seed	April-May
Pipal	May-September	Seed	April-May
Silver Oak	May-August	Seed	March-April
Tecoma	May-August	Cutting/seed	January-March
Vilayati K.kar	July-August	Seed	March-July

6. ANNUAL FLOWERS

A. Winter

Name of Plant	Planting time	Propagation method	Flowering Period
Antirrhinum	September-October	Seed	December-March
Calendula	September-October	Seed	December-March
California poppy	September-October	Seed	December-March
Carnation	September-October	Seed	December-March
Chrysanthemum (annual)	September-October	Seed/cutting	December-March
Daisy	September-October	Seed	December-March
Gazania	September-October	Seed	December-March
Hollyhock	September-October	Seed	December-March
Pansy	September-October	Seed	December-March
Petunia	September-October	Seed	December-March

Phlox	September-October	Seed	December-March
Poppy	September-October	Seed	December-March
Salvia	September-October	Seed	December-March
Sun flower	September-October	Seed	December-March
Sweet pea	September-October	Seed	December-March
Verbena	September-October	Seed	December-March

B. Summer

Name of Plant	Planting time	Propagation method	Flowering Period
Amaranthus	March-April	Seed	May-July
Aster	March-April	Seed	May-July
Balsam	March-April	Seed	May-July
Celosia	March-April	Seed	May-July
Cosmos	March-April	Seed	May-July
Portulaca	March-April	Seed	May-July
Petunia	March-April	Seed	May-July
Tithonia	March-April	Seed	May-July

C. Rainy Season

Name of Plant	Planting time	Propagation method	Flowering Period
Balsam	May-June	Seed	July-September
Celosia	May-June	Seed	July-September
Gaillardia	May-June	Seed	July-September
Gomphrena	May-June	Seed	July-September
Kochia	May-June	Seed	July-September
Marigold	May-June	Seed	July-September
Marigold	May-June	Seed	July-September
Salvia	May-June	Seed	July-September
Sunflower	May-June	Seed	July-September
Zinnia	May-June	Seed	July-September

The plants can also be planted in pots and can be kept at different places in and outside the house depending on the light requirement of the plants. For growing plants in pots, following potting mixture can be utilised :

1 part garden soil
1 part leaf mould of farm yard manure
1 part coarse sand
1 part small pebbles
2 teaspoonful of ground limestone if available
1 pinch of aldrin/BHC or any broad-spectrum insecticide available

The following points should be kept in mind for maintenance of potted plants :

1. The pots should have hole or perforations at base for drainage of excess water
2. The pots should get regularly shifted so as to get sufficient light
3. The water should be sprayed if the plants start wilting
4. Pale yellow and diseased leaves should be removed
5. The farm yard manure used for mixing in potting mixture should be well rotten

Depending on the availability of space, shade, liking of the household and climatic conditions, different types of plants can be grown to add aesthetic beauty to the houses.

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CLIMBERS FOR OUR GARDEN

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ABSTRACT

Ornamental climbers form an important aspect of our gardens. The paper deals with characteristics of climbers, their cultivation, tending and care required. An enumeration of 43 climbers suitable for the gardens in Arunachal Pradesh is also provided along with detailed information on each.

INTRODUCTION

Gardens are essential to our modern living for recreation and to reduce tension and impart an air of calm and tranquility. It is not only aesthetic but also educative and informative. As we all know the gardens contain a number of plants of varying habits, size, shape and nature. They could be annuals, biennials or perennials, of herbs, shrubs, trees or palms or any other special plant groups arranged in an elegant, orderly manner. In this assemblage of plants, ornamental climbers form an important constituent. The following lines deal with climbers for our gardens and parks.

ABOUT CLIMBERS

Climbers are weak stemmed plants either herbaceous, or woody and can be seen all around us-in home-steads, fences, open places, road sides, parks, gardens and forests. They appear as slender twiners to large woody lianas. The elephant creeper (*Entada purseatha*) is known to grow over 1.5 km. in length, making it one of the longest plant in the world. Despite their versatility they need a support to grow. Climbers have many adaptations, to suit to their climbing habit, such as hooks, thorns, tendrils, coiled stem, leaf tip or petioles. Some have clasping roots or peg roots to attach to the host surface. An interesting feature of the climbers is that they, unlike other plants, can be trained and made to bloom at a place distant from the place of planting.

CLIMBERS AS ORNAMENTALS

They are grown for their attractive flowers, foliage, fruits or for other purposes like shade or cascade. These plants could be trained and taken to long distances or given shapes. They can be used for camouflaging too. They can also act as live roof for green houses/shade houses. Such houses offer a natural habitat for the plants grown under it. It can reduce air temperature to certain extend in summer days. Many climbers flower in profusion and display a riot of colours in different seasons of the year in accordance with the selected species.

ORIGIN

A good portion of our flora are climbers. Apart from the cultivated and horticultural varieties numerous species from the wild are also equally attractive with desirable characters which can be introduced to our gardens and parks. Selection and breeding could improve their quality further. With their phenological differences these plants could be properly planned to provide an impressive look to the gardens at different seasons with a lavish touch of bright colours.

HABITAT NEEDS

Though most climbers are tropical a few of them are cool loving ones like *Crawfordia, Clematis, Holboelia* and others. They prefer rich and fertile soil with high moisture content. But at the same time there are a few hardy ones which can thrive in exacting conditions too. Majority of them prefer well lit open conditions exposed to sun. A few are shade loving and can tolerate poor light conditions making such plants ideal for indoor cultivation.

PROPAGATION

Usually propagation of climbers is through seeds, tuber, rhizomes or bulbils. Often seeds are not easily available or are of poor quality, whereby we are to look for alternative methods to produce propagules. It can be achieved through stem cuttings, branch cuttings or grafting. Vegetative propagation ensures total inheritance of characters of the mother plant. Through grafting we may be able to get different colours of flower in one and the same plant as in the case of Bougain-villa. Tissue culture and biotechnological means could also be a powerful tool to mass produce quality planting materials.

TENDING AND CARE

After planting we may need proper manuring and fertilizer application for better growth. Farm yard manure and other commercial fertilizers available commonly in the market could be used for this purpose. These plants need to be protected from pests and diseases too. In general after every new flush of leaf appeared they may be given a spray of insecticide and fungicides, available in the market. In case of any out-break of disease proper vigil and remedial sprays can save them from casualty.

As a practice, climbers require regular pruning in gardens. This is done after the flowering is over. After pruning it may be required to give an application of fungicides. During their growth they are trained using supports of timber, bamboo, cane, wires or metal frames.

SOME ORNAMENTAL CLIMBERS

The list below provides information on some of our selected climbers, both from cultivated varieties and wild species. Botanical names, family names, climatic preference, origin, nature of bloom, colour, flowering season and main use are mentioned in the list. By any means this is not claimed as an exhaustive list. Reference to standard horticulture books can bring out many such plants.

LIST OF ORNAMENTAL CLIMBERS

Sl. No.	Name	Family	Climate	Origin	Nature of bloom	Colour	Season	Use
1.	Antigonon leptopus	Polygonaceae	T/ST	Cult	Bunch	Pink	Summer Autumn	Flower
2.	Aristolochia tagala	Aristolochiaceae	T	Wild	Single	Creamy	Summer	Flower
3.	Artabotrys caudatus	Annonaceae	T	Cult	Single	Green/ yellow	Summer	Flower small
4.	Asperagus racemosus +	Liliaceae	T/ST	Cult	-	White	Summer	Foliage
5.	Bignonia venusta	Bignoniaceae	T/ST	Cult	Bunch	Golden orange	Winter	Flower
6.	Bougainvillea glabra+	Nyctaginaceae	T/ST	Cult	Bunch	Pink & many other	Winter	Flower
7.	Calamus tenuis +	Arecaceae	T	Wild	-	-	All	Foliage
8.	Cissus quadrangularis	Vitaceae	T	Wild	Bunch	Yellow	Summer	Foliage & stem
9.	Clematis loureriana +	Ranunculaceae	ST/TE	Wild	Bunch	White	Summer	Flower
10.	Clerodendrum spendens	Verbenaceae	T/ST	Cult	Bunch	Red	Summer Autumn	Flower
11.	Combretum roxburghii	Combretaceae	T	Wild	Bunch	White	Summer	Bracts
12.	Crawfordia speciosa	Gentianaceae	ST/TE	Wild	Bunch	Pink/ purple	Summer Autumn	Flower
13.	Cryptostegia grandiflora	Asclepiadaceae	T	Cult	Bunch	Violet	Summer	Flower
14.	Dischidia nummularia	Asclepiadaceae	T/ST	Wild	Bunch	White	All	Foliage
15.	Elaeagnus conferta	Elaeagnaceae	ST/TE	Wild	Bunch	White	All	Foliage/ fruits
16.	Entada purseatha	Mimosaceae	T	Wild	-	Creamy	All	Foliage/ fruits
17.	Ficus pumila	Moraceae	T/ST	Cult/ wild	-	-	All	Foliage
18.	Fissistigma bicolour	Annonaceae	T	Wild	Single	Yellow	Summer	Flower

Sl. No.	Name	Family	Climate	Origin	Nature of bloom	Colour	Season	Use
19.	Galium asperifolium	Rubiaceae	ST/TE	Wild	-	-	All	Foliage
20.	Hedera helix	Araliaceae	ST/TE	Wild	Bunch	White	All	Foliage
21.	Holboelia latifolia	Araliaceae	ST/TE	Wild	Bunch	-	All	Foliage
22.	Holmskioldia sanguina	Verbenaceae	T/ST	Cult	Bunch	Red/ Yellow	Summer Autumn	Flower
23.	Hoya lanceolata +	Asclepiadaceae	T/ST	Wild	Bunch	White/ pink	Summer	Flower/ foliage
24.	Jasminum grandiflorum +	Oleaceae	T/ST	Cult	Bunch	White/ yellow	Summer Autumn	Flower small
25.	Lonicera macrantha +	Caprifoliaceae	ST/TE	Wild	Bunch	Yellow creamy	Summer Autumn	Flower
26.	Merremia umbellata +	Convolvulaceae	T	Cult	Single	White	Summer Autumn	Flower
27.	Mussaenda glabra	Rubiaceae	T/ST	Wild	Bunch	Yellow	Summer Autumn	Flower/ sepals
28.	Passiflora edulis +	Passifloraceae	T/ST	Cult	Single	Purple	Summer Autumn	Flower/ fruit
29.	Periploca calophylla	Periplocaceae	ST	Wild	-	-	All	Foliage
30.	Piper boehmerifolia +	Piperaceae	T/ST	Wild	-	-	All	Foliage
31.	Pothos scandens +	Araceae	T/ST	Cul / wild	-	-	All	Foliage
32.	Quamoclit pinnata	Convolvulaceae	T	Cult	Single	Red	Summer	Flower
33.	Quisqualis indica	Combretaceae	T	Cult	Bunch	Pink	Summer	Flower
34.	Rivea ornata	Convolvulaceae	T	Wild	Single	Pink	Summer	Flower
35.	Raphidophora decursiva	Araceae	T/ST	Wild	-	-	All	Foliage
36.	Rosa spp +	Rosaceae	T/ST	Cult	Bunch	Pink	Autumn Winter	Flower
37.	Schefflera venulosa	Araliaceae	T/ST	Wild	Bunch	Creamy	All	Foliage fruits

Sl. No.	Name	Family	Climate	Origin	Nature of bloom	Colour	Season	Use
38.	Senecio scandens +	Asteraceae	T/ST	Wild/ cult	Bunch	Yellow	Summer	Flower
39.	Solanum jasminoides	Solanaceae	T/ST	Cult	Bunch	Violet	Spring	Flower
40.	Stephania hernandifolia	Menispermaceae	T	Wild	-	-	All	Foliage
41.	Thunbergia coccinia+	Thunbergiaceae	T/ST	Wild	Bunch	Red	Autumn	Flower
42.	Uvaria hamiltonii	Annonaceae	T	Wild	Single	Yellow	Summer	Flower/ foliage
43.	Wisteria sinensis		T/ST	Cult	Bunch	Blue	Summer Autumn	Flower/ foliage

ABBREVIATIONS

T-Tropical, **ST**-Subtropical, **TE**-Temperate, **Cult**.-Cultivated, + indicate more related species or varieties, **All** - All seasons

CONCLUSION

Climbers add beauty to our garden and are good for landscaping. They can be used for a variety of uses and places. They are a permanent asset to our gardens with their attractive flowers or foliage. To keep them beautiful and healthy a little tending and care is required. Select your choice and cultivate. Indeed they will prove to be the garlands of your garden.

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CULTIVATION PRACTICES OF ROSE

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ABSTRACT

Rose is an evergreen hardy shrubs which can be grown throughout the country with varying degree of success. It is mainly grown for cut flowers making essential oil, Rose water and gulkand. The demand for its cut flower is increasing rapidly in national as well as in international markets. Thus its commercial cultivation in scientific way is now becoming more and more rewarding and economical. This paper provides a brief account of its climate and soil requirement, cultivation methods and protection against diseases and pests.

INTRODUCTION

Rose, the queen of flowers, is adored by human beings all over the world and is used as offering to the Hindu deities, in the hairdo of the ladies and for making of garlands, bouquets, wreaths as well as for floral arrangement. According to the classification of Reader, an American taxonomist, about 120 species of roses are in existence. These are distributed in temperate and tropical zones of New Mexico, North America, Abyssinia, North East Africa, the Himalayan region of India and in mountains of Japan and China. There are 10 species of roses growing wild in India. So far as garden roses are concerned, only about 8 wild species have played a major role in the development of hundreds of varieties of beautiful and colourful roses, which adore the gardens world over.

IMPORTANT CLASSES OF GARDEN ROSES

1. **Tea Rose** : It arises as a cross between the European and Chinese roses. These roses have big size flower, resistant to cold and has distinct fragrant. However they are susceptible to winter diseases.

2. **Hybrid perpetuals** : These are obtained by crossing between *Rosa damascena* x *Rosa gallica*. The characteristics of these roses are vigorous growing habit, large full flowers, highly fragrant and resistant to winter diseases.

3. **Hybrid Tea Rose** : The origin of these classes was from the result of crossing between the Tea Roses and Hybrid perpetuals. The plant may be upright or spreading and dwarf, medium or tall. The range of odour in Hybrid Tea Rose is fantastic, with all the colours, except true blue and true black. They have typically large flowers with many petals. Stripped or streak variety and bicolour flowers are also available in this class.

4. **Dwarf polyantha** : Originated as cross between *Rosa multiflora* and *Rosa chinensis.* They produce enormous clusters of small flowers, blooms for several months and are cold resistant.
5. **Floribundus** : Originated as a cross between dwarf polyantha and Hybrid Tea Roses. They produce small clusters of flowers, blooms for a longer period and some of the varieties of this class are scented.
6. **Rambling Roses** : Rambling roses are evolved from *Rosa wichuraiana.* Small flowers are produced in large clusters and last from 4-6 weeks. Rambling roses are not suitable for growing in plains except the variety 'Delhi Pink Pearl'.
7. **Climbing Roses** : Originated as a cross between Hybrid Tea Rose as a budsport. All the characteristics of the climbing Roses are similar to that of Hybrid Tea Rose except the climbing habit.
8. **Miniature Roses** : Evolved by crossing with *Rosa lorencianlia* and *Rosa elletii.* The characteristics of Miniature Roses are small stems, leaves and flowers, suitable for growing in pots, boxes and as border plants and beds.

Other classes of garden roses are Grandiflora, China Rose, Bourbon Rose, Cabbage Rose, French Rose, Albas Rose, Noisette Rose, Scot Rose, etc.

CLIMATIC REQUIREMENT

The rose grows best in dry cold localities. It does not thrive well in hot humid climate. The best night temperature is from 60-65°F and day temperature from 70-75 °F.

SOIL

Well drained garden loamy soil with slightly acidic is good for growing roses.

TIME OF PLANTING

In northern India (plains) it is best to plant during Sept.-Feb. and in the hilly regions it is planted during Feb. – Oct.

METHOD OF PLANTING

At the time of planting, each pit should receive about 5-8 kg. of Farm Yard Manure, a handful of bone meal and 3 gm of Aldrin or B.H.C. dust. These are well mixed with the soil and fill the pit properly with this mixture. Then, a small hole is dug at the centre of the pit and the plant with earth ball or bare rooted is lowered in the pit. In the case of bare rooted plants, the roots are to be spread out properly. The point of bud union shall be kept well above the ground level. The soil round the stem must be made firm by treading with feet or otherwise.

The planting distance varies from 60-75 cm from plant to plant and row to row depending upon the cultivar. Cultivar such as 'Queen Elizabeth', 'Happiness' and 'Super Giant' grow vigorously and need wider spacing. The planting distance are 90-120 cm in standards, 3 m in climbers, 45 cm in Polyanthus, 75 cm in Hybrid Tea Rose, 60 cm in Floribunda and 30 cm in Miniature.

AFTER CARE

Immediately after planting, the plants are watered thoroughly. The branches may also be sprinkled one or more times a day. The soil be sprinkled one or more times a day. The soil should be hoed tightly between two irrigation with a fork when the surface begins to dry up. The suckers arising from the root stocks need to be removed immediately. Disbudding or removal of axillary buds is practiced to obtain better quality blooms in subsequent flushes. Pruning and manuring should be done at appropriate time. Frequent light irrigation is harmful, hence, heavy irrigation should be given at each irrigation.

PROPAGATION OF ROSE

Roses can be propagated from seeds, cuttings, layering, budding and grafting.

Seeds :

To produce new hybrids through breeding, the seeds formed in the fruits, known as hips are sown for obtaining hybrid seedlings.

Cuttings :

Climbers, Ramblers, Polyanthas and Miniature roses are propagated by cuttings. The most important use of cuttings is to raise root stocks for budding.

Layering :

For the multiplication of climbers and Ramblers this method is widely used.

Budding and Grafting :

For commercial propagation budding is widely adopted. The best time of budding in north India is during Feb.-March, although budding can be done during October also. Common used root stocks for budding and grafting are Edouard Rose *(R. bourboniana)*, *Rosa indica* var. *Odorata* and *Rosa multiflora.*

Height of budding :

Standard rose	:	The standards are budded at 1 m height.
Half standard	:	35 cm – 45 cm height.
Full standard	:	110 cm
Weeping standard	:	150 cm – 2 cm
Bush type	:	5 – 10 cm above the ground level.

PRINCIPLE OF PRUNING

The general principle of pruning is that all dead, diseased or insect infested wood and the weaker branches are to be removed. A sharp cut an angle of 45° and about 5 mm above a healthy bud is given. Flowering begins 6 weeks after pruning

Time of pruning :

In most parts of India, pruning is done during October. In temperate region, pruning is done after winter. In our climate, pruning is done after spring.

Type of pruning :

Depending upon the extent and level of shortening, there are three types of pruning i.e., light pruning, moderate pruning and hard pruning. In light pruning, the healthy shoots, left after thinning of diseases and unwanted portion, are cut either at the second or third eye immediately below the flower bearing root-stalk.

Moderate pruning is done by cutting back at the main lateral shoots of the previous year's growth at an outward growing eye, at about half the length of the growth.

Hard pruning consists of keeping only three or four shoots of the last year and heading back at about three or four eyes from the base.

The types of pruning differs for all types of roses. After pruning as a preventive measure, spraying of fungicide, captan is advisable.

MANURING AND FERTILIZATION

Roses are heavy feeders. There are different formulation of fertilizer mixture for roses.

Formulation recommended by the Royal National Rose Society of England, may be followed as-

1.	Nitrate of potash	6	part by weight.
2.	Sulphate of ammonia	3	part by weight.
3	SSP	16	part by weight.
4.	Sulphate of potash	8	part by weight.
5.	Sulphate of magnesium	2	part by weight.
6.	Sulphate of iron	0.5	part by weight.

100 gram per bush of the above mixture is applied into the soil after pruning.

B. P. Pal, the well known Indian Rose expert, has recommended the following fertilizer mixture.

1.	Groundnut cake	5 kg.
2.	Bone meal	5 kg.
3.	Ammophos (11:48)	2 kg.
4.	SSP	2 kg.
5.	MOP	1 kg.

The mixture is applied @ 50-60 gram per plant.

Liquid feeding :

Liquid manure is prepared by fermenting sesame, neem or mustard oil cake and given when flower buds have formed and till their opening. The liquid should be digested to a pale straw color before applying and should be applied @ 2-5 lit. per square meter area.

Liquid manure can also be prepared by dissolving quick acting chemicals such as Nitrate of potash and Phosphate of potash @ 30 gram each in 15 lit. of water. About 5 lit. of this liquid is added to each square meter at 5-7 days intervals during the period when buds begin to form until they bloom.

Foliar feeding :

A foliar spray is prepared by dissolving 14 gram of the following mixture in 10 lit. of water and sprayed at fortnightly intervals.

1.	Urea	1-2 parts.
2.	Dihydrogen ammonium phosphate	1 part.
3.	Potassium nitrate	1 part.
4.	Potassium phosphate	1 part.
5.	Liquid soap (as a spreader)	14 gram.

To supply trace elements, the following mixture may be used as foliar spray.

1.	Magnesium sulphate	7 gram.
2.	Ferrus sulphate	7 gram.
3.	Borax	3.5 gram.

7 gram of the above mixture may be dissolved in a liter of water and sprayed along with soap once a month or three months depending upon the circumstances.

This spray will help to obtain bright coloured flower. But the above two mixtures should not be mixed together but sprayed separately. All foliar sprays should be done before 8 am on a sunny day and spraying should be avoided when the flowers have opened.

INSECT PESTS AND THEIR CONTROL

Red scale, aphid, thrips, leaf cutting beetle, dragon wasp, mite are the major insect pests. Red scale can be controlled by spraying Folidol E 605 @ 2 ml per liter. Mite can be controlled by Aldrin @ 1 ml. Per lit. The other insects can be controlled by spraying Malathion @ 1ml. per liter.

IMPORTANT DISEASES AND CONTROL

1. Dieback : Causal organism *Diplodia rosarum*, control-0.2% captan.
2. Powdery mildew: control- Bevistin 2 gram per liter.
3. Black spot: Causal organism *Diplocarpon rosae*, control-Benlate 0.5 gram per lit.

Table : Some of the Indian Cultivars of Garden Roses.

Class	Cultivars	Colour
Hybrid Tea Rose	Dr. Homi Bhaba, Jawahar, Mridula	White
	Kankanji, Purnima, Basant, Ganga	Yellow
	Bhim, Raktagandha, Lalima	Red
	Dr. B.P. Pal, Mrinalini Surabhi, Madhumati	Pink
	Ranjana, Aruna	Orange red
Floribunda	Chandrama	White
	Arunima	Pink
	Surya kiran, sindur, Deepsikha,	Orange red
	Suryadaya, Usha, Srinagar	
Polyantha	Swati, Chattilon rose	Pink
	Ideol	Dark red
	Cri-Cri	Red
	Little firt	Bright red
	Little sunset	Sunset yellow
	Sweet fairy	Pink
Climbing	Prosperity	White
	Golden shower	Yellow
	Cock tail	Red with yellow centre
Striped Rose varieties	Anvil sparks	Coral red with yellow strips
	Careless love	Pink with white strips
Export varieties	Golden times, Marcedes, Belinda, Red success, Sonia, Montreal	

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SIGHTING OF WHOOPER SWAN (CYGNUS CYGNUS) IN NAMDAPHA TIGER RESERVE, ARUNACHAL PRADESH

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ABSTRACT

Swans are the large aquatic birds found in the cooler parts of the world. The record of sightings of the swan in India are very few, around a dozen occurrences recorded within our limits, that also sporadically during the current century. No records of their occurrence in Namdapha are available so far. The present paper is the first record of whooper Swan from for eastern part of India at Namdapha Tiger Reserve. The Swans are vagrant winter visitor to India and more studies are required on their migration routes and conservation.

INTRODUCTION AND STUDY AREA

Namdapha Tiger Reserve (NTR) is located at the junction of the Indian subcontinent bio-geographic region and the Indo-China bio-geographic region (Dinerstein, 1997). It is part of the Eastern Himalaya Bio-geographic Province under the Himalayan Bio-geographic Zone in the Indian sub-continent Bio-geographic Region (Rodgers and Panwar, 1988). It lies between 27°23'30" to 27°39'40" N Latitude and 96°15'20" to 96°58'33" E Longitude covering 1985 Sq. Kms. of geographical area. It is bounded in the East and South by the Indo-Myanmar international boundary. The Kamlang Wildlife Sanctuary (783 Sq. Kms.) forms the northern boundary. The altitude ranges from 200 m to 4571 m. This protected area is wedged between Dapha Bum ridge of Mishmi hills and northern limit of Patkai hills. The area receives around 1991 mm of annual rainfall spread over nine months through northeast monsoon as well as southwest monsoon. The temperature in valleys ranges from 3° C to 37° C and the relative humidity ranges between 35% to 70%. In the higher reaches the temperature goes down appreciably below freezing point and rainfall also increases with increase in altitude.

The large altitudinal variation coupled with higher precipitation has resulted in the rich diversity of the floral and faunal composition of the tiger reserve. The vegetation types in the tiger reserve have been broadly grouped into tropical, sub-tropical, temperate, sub-alpine and alpine forests.

However, as per the classification of forest types of India by Champion and Seth (1968) following vegetation types are found in Namdapha Tiger Reserve.

1. Assam Valley Tropical Wet Evergreen Forests (IB/C-1)
2. Upper Assam Valley Tropical Evergreen Forests (IB/C-2a)
3. Upper Assam Valley Tropical Evergreen Forests (IB/C-2b)

4. Upper Assam Valley Tropical Semi-Evergreen Forests (2B/C-1)
5. Sub-Himalayan light alluvial Semi - Evergreen Forests (2B/C1/S1)
6. Secondary Moist Bamboo tracts (2/2S1)
7. Eastern Hollock Forests (3/1S2b)
8. Eastern Himalayan Moist Temperate Forests (12/C-3)
9. Moist Alpine Scrub Forests (15/C-1)

Although the region is 27^0 N of the tropics, the climatic conditions with favourable rainfall coupled with high temperature gradients and high humidity makes the vegetation characteristics of the tropical evergreen forests.

Flora and Fauna

Namdapha Tiger Reserve is the home of four big cats of the world : tiger (Panthera tigris), leopard (Panthera paradus), clouded leopard (Panthera nebulosa) and snow leopard (Uncia uncia). As per the report of the Zoological Survey of India (Ghosh, 1987), the fauna consists of 15 species of earthworm and leeches, 430 species of insects, 140 species of butterflies, 76 species of fishes, 25 species of amphibians, 50 species of reptiles, 453 species of birds and 96 species of mammals. The rare species are Malayan Sun Bear and Red headed parrotbill bird. The contribution to the world in the form of new and endemic species from the Namdapha are Namdapha flying squirrel, Namdapha short wing bird, 6 species of fishes and 4 species of amphibians. The Botanical Survey of India in its report has documented 1046 species of plants from this PA (Sharma, 1990).

It is pertinent to mention here that so far only 40% of the area of the NTR has been surveyed and the remaining 60% is yet to be surveyed and explored.

Swans and their distribution.

Class : Aves
Order : Anseriformes
Family : Anatidae
Genus : *Cygnus* (7 spp.) and *Conscorboa* (1 spp.)

Swans are large, long-necked aquatic birds. They are largest of waterfowl reaching 15 kg or more in weight with wingspans of over two meters. Out of eight species of swans found all over world, seven species belonging to genus *Cygnus* are similar in their basic shape with large and heavy body, long and sinuous neck, flying with slow wingbeats with their necks outstretched. They feed by probing their heads under water (dabbling) to graze on aquatic plants in shallow depths. *Coscoroba* swan may not be true swan because its characteristics suggest that it provides a link between the swans and geese and another group, the whistling ducks. It derives its name from the peculiar calls. It breeds in the southern part of South America and migrates north to warmer areas during winter (Grezimek and Bernhard, 1975).

Out of the seven species of swans two are found in the southern hemisphere. They are black swan (*Cygnus atratus*) and black necked swan (*C. malacocorypha*). The black swan is naturally confined to Australia but has been introduced elsewhere also and now flourished in New Zealand. The black necked swan is found in southern parts of South America.

The other five species of swans are all found in the Northern Hemisphere. The adult have white plumage, though they have bills of different colours. The Trumpeter Swan (*C. buccinator*) is largely resident and breeds in northwestern USA and Southwestern Canada. The Whistling Swan (*C. columbianus*) breeds in high arctic region of western Canada and Alaska and winter largely on the eastern and western seaboard of the United States of America. The Bewick's swan (*C. bewickii)* breeds in high arctic across Russia and Siberia and migrates south for the winter, many of them being seen in Europe. The Whooper Swan (*C. cygnus)* breeds largely to the south of the Bewicki breeding areas and in Iceland. A few pairs breed as far south as Scotland. They migrate to milder areas to the south and can be seen in Britain. The mute swan (*C. olor*) breeds largely south of the Whooper. It is resident in Europe, but may have to migrate to warmer parts of Asia and Southern Europe in winter (Meyer, 1984).

Observation on the behaviour of the Whooper Swan

During November, 1998 two groups of swan consisting of four and three members, respectively were seen in the Noa-Dehing River near Ramnagar village (Longitude 96°54′ Latitude 27°10′). The first group consisting of four members was nearly 75-100 m ahead of the second group of three birds. They were swimming downstream along the current of the Noa Dehing river carrying the neck vertically and the beak horizontally. The birds were of the size of vulture, having overall white plumage. The long and slender neck was nearly half of the length of the body. The yellow patch was clearly visible on the bill. They were swimming and feeding in the water, submerging their head and neck, up-ending like ducks, and coming out with vegetative matter which they would eat. They would sometimes dive inside the water, emerging after nearly 4 - 5 minute after covering a distance of 25 to 30 m downstream.

When disturbed they initially tried to swim away or to dive inside the water, but after some time they took off from the river, with considerable effort, running some distance on the water surface before getting airborne. Once airborne, they would fly gracefully and land nearly 250m ahead in the water and start swimming. Their flight was deliberate in a straight line with slow wing beats, necks outstretched and legs curled behind. Highly vocal, their call were monosyllabic, clear and strong, and distinctive. The calls were heard clearly for more than 200m inspite of sound created by the swift flowing water of the river.

The local population of the Ramnagar and Gandhigram confirmed about the arrival of these swans every year. They informed that the arrival of these swans was linked to the snowfall on the higher ridges of the mountains in the region. During 1999, the swans arrived a little late, first group of three birds being seen in the middle of December.

Protection measures needed.

For any effective long term conservation measures, the study has to be carried out immediately on the migration time, route and pattern alongwith habitat use feeding behavior by the Whooper Swans. Sustainable protection measures are not possible without the active participation of the people of Gandhigram, Ramnagar and Vijoynagar. Thus, the environmental education and awareness among the masses about the need for protection of these migratory birds are indispensable and has to be carried out because the local population in the region is basically non-vegetarian and there are every likelihood of its being killed for somebody's palate. Moreover, the population of the migratory bird is too small to withstand any adverse situation.

Besides this, the stray dog's population has to be controlled, particularly along Noa-Dehing river in Vijoynagar/Gandhigram area. The protection measures need to be taken up by developing temporary camps along the Noa-Dehing river and posting of dedicated staff in these camps from October to the March/April i.e. the period during which these migratory swans arrive and stay in this area.

ACKNOWLEDGEMENT

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RESEARCH NOTE

LINEAR MEASUREMENTS FOR LEAF AREA ESTIMATION

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Among the different growth parameters (i.e. girth, height etc.) leaf area is the most reliable index for determining the performance of plants as the leaves are the main assimilating organs and chiefly concerned with photosynthesis. Various techniques are used for measuring the leaf surface, i.e. plotting the leaves lamina on centimeter graph paper and counting the square, preparing blue prints of leaves and determining the area by planimeter and dry matter area basis of individual leaf, but these methods are time consuming and laborious. On the other hand, very sophisticated instruments like leaf area meter, are available in market. However, use of such costly instruments for determining the growth performance in terms of leaf area in forestry plantations where semi skilled personnel are engaged, is not feasible. It is therefore, imperative to develop rapid, accurate and non destructive estimates of leaf area for timber species.

The present study deals with the development of simple, reliable and non-destructive method of calculating the leaf area of four tree species viz., **Anthocephalus cadamba, Elaeocarpus genitrus, Gmelina arborea** and **Mesua ferrea**, commonly raised in social forestry/avenue plantations of North-Eastern region.

For this purpose, 150 leaves were collected randomly from upper, middle and lower canopy of each selected tree species growing in and around the NERIST camps. Length and breadth of each leaf was recorded for each individual species. Area of each leaf was also measured by using the graph paper and counting the squares. The leaf area determined by length x breadth was higher in each case than the actual area of individual leaf obtained from graphical method (Table 1). A constant factor (K) for individual species was calculated by dividing the actual leaf area with the product of length and breadth of the leaf.

Reliability of obtained constant factor was tested by multiplying length x breadth of the leaf x K through another set of leaves collected from individual growing in different locality and compared with their actual leaf area. The estimated leaf area obtained through the above mentioned procedure was comparable with actual leaf area (graphical method) (Table 2) and it was within the range of experimental error allowed for such biological measurements.

It is evident from the results that the leaf area could be determined by simply multiplying the product of length and breadth of leaf with the constant factor (K) of individual species. Use of such linear measurement is often less time consuming and does not require any expensive instrument.

Table 1 : Mean Length, breadth, actual and estimated leaf area (n=150) of four tree species (±SE)

Tree species	Leaf length (L) (cm)	Leaf breadth (B) (cm)	L x B (cm2)	Actual Leaf area (A) (cm2)	Value of constant (K) (A/L x B)
Anthocephalus cadamba	24.7 ±3.2	14.7 ±1.7	363.09 ±13.5	283.75 ±15.7	0.78
Elaeocarpus genitrus	12.52 ±1.3	3.16 ±0.4	39.56 ±3.4	28.33 ±2.6	0.72
Gmelina arborea	18.20 ±1.8	8.94 ±0.7	162.71 ±5.2	118.90 ±4.9	0.72
Mesua ferrea	12.13 ±1.3	3.13 ±0.3	37.96 ±3.6	24.62 ±2.7	0.65

Table 2 : Reliability of estimated area of the leaf (n=45) collected from the individuals growing in different locality.

Tree species	Leaf length (L) (cm)	Leaf breadth (B) (cm)	L x B (cm2)	Actual Leaf area (A) (cm2)	Estimated Leaf area (cm2) LxBxK	Different (%) estimated from actual
Anthocephalus cadamba	28.3	14.2	401.86	304.5	313.45	2.94
Elaeocarpus genitrus	13.3	3.2	52.56	29.3	30.64	4.57
Gmelina arborea	18.3	9.8	179.34	125.7	130.92	4.15
Mesua ferrea	12.2	3.4	38.08	23.6	24.75	4.88

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NEWS AND NOTES

GREGARIOUS FLOWERING OF DENDROCALAMUS HAMILTONII IN TEWAI-RUSSA AREAS UNDER KANUBARI RANGE OF DEOMALI FOREST DIVISION

During the field survey and enumeration of Eujen, Russa-Chopsa and Chopnus VFRs under Deomali Forest Division gregarious flowering of *Dendrocalamus hamiltonii* locally called Kako bamboo spread over an area of approximately 30.00 sq.kms. was observed. In some of the locality the bamboo flowering was in progress, the seeds were ripened enough and the clumps were drying. In the Tewai area, the gregarious flowering was over and nearly all the clumps of this species were completely dead and dried . Profuse natural germination in and around the parent clumps and also in the sandy area along Tewai river bed was observed.

No recorded year of last gregarious bamboo flowering in past in this area is available.

This bamboo is very useful to the local people as the young shoots are eaten as vegetable. Being thin walled and rather soft it is not very good for building purposes but much in use for mat work, basket, fencing and fodder to animals.

(Communicated by Shri Umesh Kumar, D.F.O. Deomali)

NEGATIVE LIST OF EXPORT OF PLANTS

Publication notice 47 "ITC(HS) Classifications of Export and Items 1997-2002" relating to export of plants, plant portions and their derivatives and extracts obtained from the wild shall be amended as under : -

i) The export of plants, plant portions and their derivative and extracts obtained from the wild as under is prohibited.

1. *Beddomes cycad (Cycas beddomei)*
2. *Blue vanda (Vanda coerulea)*
3. *Saussurea costus*
4. *Ladies slipper orchid (Paphiopedilium species)*
5. *Pitcher plant (Nepenthes Khasiana)*
6. *Red Vanda (Renanthera imschootiana)*
7. *Rauvolfia serpentina (Sarpagandha)*
8. *Ceropegia species*
9. *Frerea indica (Shindal Mankundi)*
10. *Podophyllum hexandrum (emodi) (Indian Podophyllum)*
11. *Cyatheaceae species (Tree Ferns)*
12. *Cycadecea species (Cycads)*

13. *Dioscorea deltoidea (Elephant's foot)*
14. *Euphorbia species (Euphorbias)*
15. *Orchidaceae* species (Orchids)
16. *Pterocarpus santalinus* (Red Sanders)
17. *Taxus wallichiana* (Common Yew or Birmi leaves)
18. *Aquilaria malaccensis* (Agarwood)
19. *Aconitum* species
20. *Coptis teeta*
21. *Coscinium fenestrum* (Calumba wood)
22. *Dactylorhiza hatagirea*
23. *Gentiana kurroo* (Kuru, Kutki)
24. *Gnetum species*
25. *Kampheria galenga*
26. *Nardostachys grandiflora*
27. *Panax pseudoginseng*
28. *Picrorhiza kurrooa*
29. *Swertia chirata* (Charayatah).

ii) Plant and Plant portions, derivatives and extracts (including value added herbal formulations) of the cultivated varieties of the above species (excluding Sl. No. 16) will be allowed for export subject to production of a Certificate of Cultivation from the Regional Deputy Director (Wildlife), or Chief Conservator of Forests or Divisional Forest Officers of the State concerned from where these plants and plant portions have been procured. However in respect of the cultivated varieties of the species as covered by Appendix 1 (Sl. No. 1 to 6 of Paragraph 2 above) and Appendix 2 (Sl. No. 7 to 18, 26, 28 of paragraph 2 above) of CITES, a CITES Permit for export will also be required.

iii) The value added herbal formulations made out of imported species of plants and plant protions as specified in paragraph 2 above will be allowed freely without any restriction subject to furnishing of an affidavit to the Customs authorities at the time of export that only the imported plant species as above have been used for the manufacture of value added herbal formulation being exported. In the event of affidavit proving to be false, on the basis of random sample tests, action would be initiated against the firm under the Foreign Trade (Development and Regulation) Act, 1992.

iv) Exports allowed only through the ports of Mumbai, Calcutta, Delhi, Chennai, Tuticorin and Amritsar.

Source : Export -Import Policy : In Wildlife Trade : A Handbook for
Enforcement Staff. WWF-India & Traffic India. 1998.pp 43Ñ

MAHA VRIKSHA PURASKAR.

The field Director, Project Tiger, Namdapha National Park, Miao Shri D.N. Singh, IFS received the Maha Vriksha Puraskar instituted by the Ministry of Environment and Forests, Govt. of India. The award was given for preserving monumental tree of Hollong (*Dipterocarpus retusa*) in the park. This award is expected to boost the biodiversity Conservation efforts taken up by the field Director and his team.

INFRASTRUCTURE ADDED

During 1999-2000 a very sophisticated hardening unit was commissioned at the Orchid Research Centre of SFRI at Tipi under an Orchid extension project sponsored by ICFRE, Dehra Dun. This will help in hardening of Tissue cultured seedlings and greatly enhance the survival percentage of transplanted seedlings from culture flasks to field. The unit is capable of regulating various environmental parameters like temperature, relative humidity and light through its automatic control systems.

FARMERS TRAINING ORGANISED

The Orchidology Division of the State Forest Research Institute organised a farmers training at Ziro (Hapoli), in Lower Subansiri district from 13th and 24th November, 1999. The training was attended by local women and entrepreneurs. The training was organised by the SFRI, Itanagar under the fund support from ICFRE Dehradun. The training was conducted on the technique of orchid cultivation. nurseries development and the awareness of the commercial potentialities of the orchid in the state as an alternative sources of income to the people and the state.

FOLKLORE MEDICINAL PLANT WORKSHOP

SFRI took part in a workshop on folk lore medicinal plants and local tradition organised at Pasighat by Arunachal Vikaș Parishad and other NGOs. SFRI has also put up an exhibition highlighting the medicinal plant wealth and its prospects in economic development of the state and health care in Arunachal Pradesh.

FIRST CANETUM IN NORTH EAST INDIA ESTABLISHED

Under a project "Conservation and regeneration of rattans (Canes) in north east India with special reference to Arunachal Pradesh" funded by ICFRE, the SFRI has established the first ever Canetum (Cane garden housing different species) at Karsingsa and Chessa in Papum Pare district, Arunachal Pradesh. Out of the total 24 species of Rattans/Canes in the region 14 species have been introduced into these well laid out plots. Apart from Arunachal Pradesh species from Assam are also incorporated here. All the 4 genera of canes are has been preserved here. This venture is expected to significantly contribute towards the conservation of this highly valued and depleting forest resource. This will also facilitate studies on regeneration, silviculture, phenology, growth and breeding on different cane species.

◆◆◆◆◆◆◆

Book Review

Many books have been written on nursery and planting techniques of forest tree species, but a recently published book "**Nursery and Planting Techniques of Forest Trees in Tropical South Asia**" written by **Dr. S. N. Rai** adds to our knowledge on this important subject. The author has described various methods, basic requirements and precautions alongwith many practical tips, needed to raise seedlings of a wide range of economically important tropical tree species. The book is not only intended for foresters, tree growers and students interested in this discipline but will be equally useful for a layman and a tree lover.

The contents of the book are covered in four chapters. The first chapter on Forest Nursery covers various aspects of nursery management, starting from establishment and requirements of different types of nurseries, methodology and problems commonly met in raising quality seedlings for different purpose. The second chapter dealing with nursery and plantation techniques of 68 most important, indigenous and exotic tree species, is an exhaustive compilation, enriched with the personal experience of the author of over 30 years in the field of forestry. Of all the species covered in the book, nearly 40 species are also found in North-East India, thereby making this book useful for the tree growers of this region. Detailed information required for propagation of a species, such as climatic requirements; flowering, fruiting habit and period; seed collection, processing, pretreatment techniques and viability of seed, etc are provided. The nursery and plantations techniques are supplemented with data on germination, survival and growth parameters of selected species. The book provides information on early growth of root system of seedlings alongwith detailed figures, a significant aspect in success of plantations, which is unique and generally not available in many publications on this subject. However, an important technique, i.e. the use of root trainers, which helps in better development of the root : shoot ratio and prevents coiling of roots, has not been covered in the book. The planting technique of each species is well described and has significantly increased the scope of book.

Complete methodology and results of various grafting techniques suitable for vegetative propagation of 10 species of horticulture and forestry, is another significant compilation. Selection, preparation of root- stock and scion, stepwise procedure for budding, grafting and layering etc of different types of cuttings are described with figures and has increased the utility of book. Due importance to these techniques of clonal propagation is generally not given in forestry sector and hence this is one of the main reasons for non-availability of quality planting stocks for large scale afforestation in forestry. Insightful comments about regeneration, diseases and other aspects of natural history of forest tree species are scattered through out the text and special sections on the preparation of soils, media, watering, hardening and quality of seedlings further enhance the utility of this book. The book, published by Punarvasu Publications, Pentagon House, Kalaghatagi Road, Dharwad – 5980 002, Karnataka, is priced at Rs. 400/- and is a must for each Forest Division and field units of Forest Departments. It will help in successfully raising the nursery seedlings and tree plantations of suitable species in tropical South - Asia.

Dr. S. N. Rai has done a yeoman service to the forestry sector by sharing his knowledge with This work highlights the importance of documenting the basic and practical knowledge of ng forest trees. The rate at which we are accumulating information about our native forest trees ry slow. In such times, when natural habitats and their representative biodiversity is fast disappearing, information provided in the books like this will greatly help in our efforts to green the earth, to ore degraded lands and conserve the natural resources.

(Sudhir P. Ahlawat)
Scientist,
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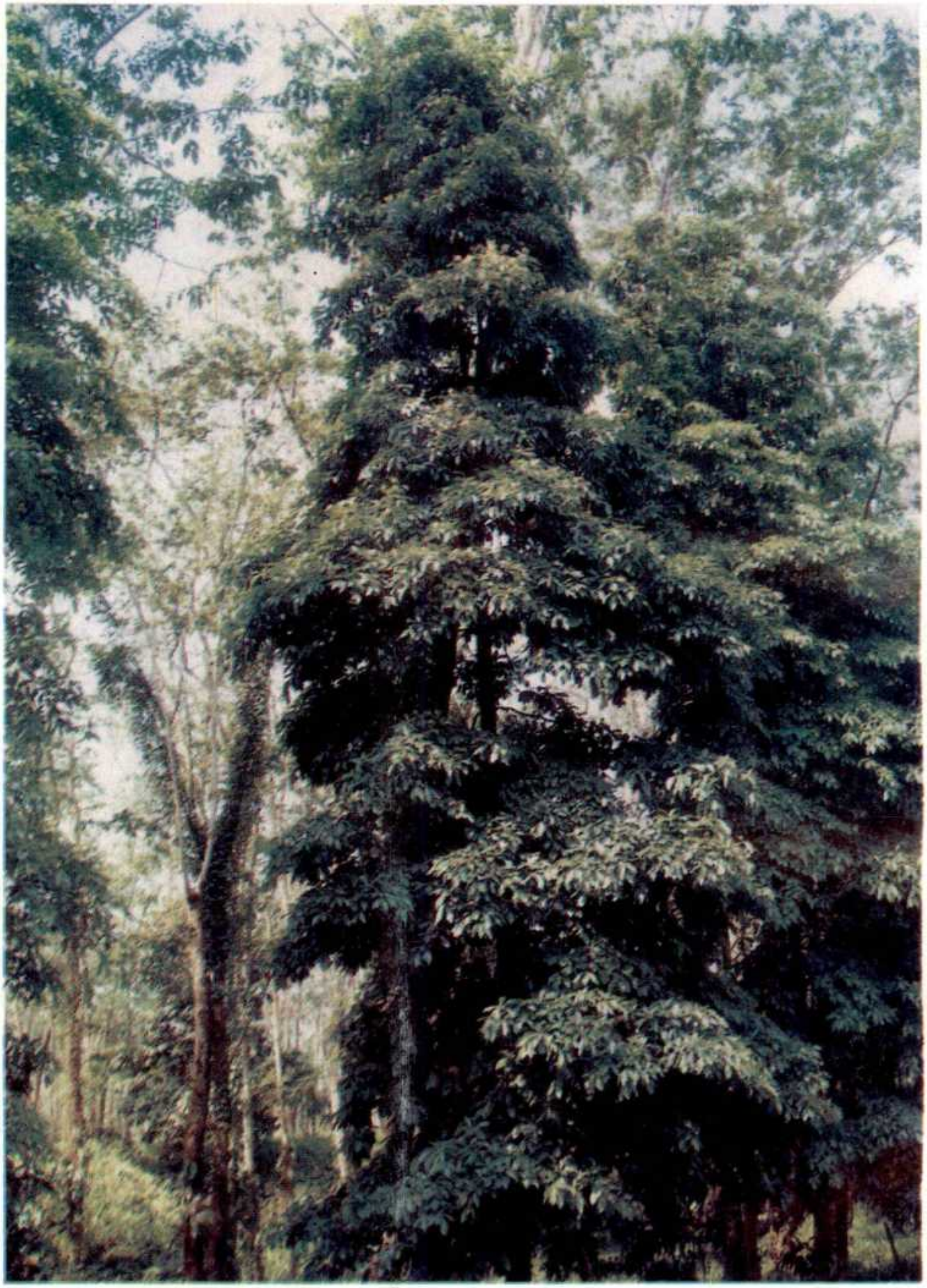

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Front Cover : A well grown clump of *Bamboosa arundinacea* at Van Vigyan Kendra, Chessa.

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EDITORIAL

With the turn of the millennium, there has been a gradual shift in the development and utilization of biological resources from that of exploitation of timber, to the sustainable use of non-timber forest produces with an emphasis on conservation of biological resources *vis-à-vis* environment as a whole. Realizing that the natural resources are not limitless and rather exhaustible with disastrous consequences on the future generations, governments world over have begun to pay attention on conservation issues in all the development programmes. The world Conservation Union – the International Union for Conservation of Nature and Natural Resources (IUCN) has amply highlighted the importance of conserving the vanishing species and maintenance of biological diversity.

Under the Species Survival Commission, the World organizations like The United Nations Development Programmes (UNDP), World Trade Organization (WTO), Convention of International Trade in Endangered Species of Flora and Fauna (CITES), etc. have come up with concrete proposals for addressing the conservation issues at the national and global level with the slogan "**Think globally and act locally**".

In India, intervention of Honourable Supreme Court since December 1996 has streamlined the national laws for protection and conservation of forests and environment in our country, with beneficial effects.

In this volume of Arunachal Forest News, articles relating to the role of Judiciary in Forest conservation, conservation of North-east flora and biodiversity, sustainable development of Non-Timber Forest Produces (NTFPs) like bamboos, canes, medicinal plants, orchids and wild edible plants used by ethnic communities have been published. The enormous potentials of developing NTFP based economy – especially bamboo in the North-East India, Arunachal Pradesh in particular would certainly revolutionize the modern wood-based industries replacing timber, thereby conserving our forests and developing rural economy closely linked with the ethnic communities. Supplementing these, medicinal plants, orchids and other minor forest produces dealt in this volume of Arunachal Forest News would contribute in creating awareness for sustainable development involving the local communities in managing the forests, biodiversity and environment locally, contributing to the development of **green globe** in the New Millennium.

S. N. Hegde

JUDICIARY - ITS ROLE IN FOREST CONSERVATION

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ABSTRACT

The rapid industrial development and development of supportive infrastructure has resulted in the loss and degradation of ecology and forests. Notwithstanding the fact that various laws and regulations to preserve forests and environment were in force, the declining trend of forest cover and their health in the country could not be arrested. The immediate attention of policymakers was in providing *Roti, Kapda* and *Makan* to needy people. Lately, such alarming situation of degradation and loss of forests and environment caught attention of the Nation and its people realising that providing the above basic needs would remain a distant goal unless effective steps to preserve basic life support system namely forests are not protected and conserved. The Supreme Court of India in a Public Interest Litigation (PIL) namely Writ Petition filed by Shri T. N. Godavarman Thirumulpad, the W.P 202 of 1995 T.N. Godavarman V/S Govt. of India and others has passed various directives to ensure protection and conservation of forests in perpetuity. The article deals with some of the directives of the apex Court having far reaching consequences in this regard.

INTRODUCTIOIN

Shri T.N. Godavarman Thirumulpad of Nilambur, Kerala filed a Writ Petition under Article 32 of the Constitution of India, in public interest for and on behalf of people living in and around the Nilgiri forests of Western Ghats to protect tropical rainforests from degradation. The petitioner, a trustee of the Nilambur Kovilakom requested the apex Court to restrain the authorities from allowing any activity in forest of Nilgiri – Gudalur which results in the cutting, removal or destruction of the forest. The Supreme Court in view of the nature of the petition and points involved therein issued notices to the State Governments and Government of India for response. The various directives issued since 12.12.96 to ensure protection and conservation of forests in the country have been presented and discussed in this article.

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*Principal Chief Conservator of Forests; ** Deputy Conservator of Forests

DIRECTIVES OF THE SUPREME COURT

Concerned about the condition of forests throughout the country, the Supreme Court of India in writ petition (Civil) No. 202 of 1995 regulated felling of trees and diversion of forests land for non forestry purposes. It also defined the word "forest" and clarified that it should be understood according to its dictionary meaning. With this, all forests irrespective of their legal status came under the purview of Forest (Conservation) Act 1980 (FCA). The apex court directed that the felling of trees in future should be done only in accordance with working plans approved by GOI. Visualising the situation in which felling being resorted without giving equal importance to regeneration, the apex court on 22.09.2000 ordered that regeneration commensurate with felling is a prerequisite for future fellings. The N.E. region having large extent of forests caught specific attention of the apex court. As interim measures, the apex court had also banned the movement of timbers from any of the seven north eastern states to any other state of the country either by rail, road or water ways. This ban however excluded movement of certified timber required for defence and other government purposes. From time to time the apex court passed various directives to streamline working in forests to ensure that they are protected and conserved for future environmental security. While delivering its interim order on 12. 12.96, the court regulated felling of trees and suspended all non-forestry activities in forest areas except in accordance with the provisions of law. In its order at 4.03.97 it clarified that Minor Forest Produce (MFP) including bamboos are exempted from such interim directions. Thus the apex court, while ensuring check on degradation and loss of forests by undesired elements, showed real concern for local population mainly dependent on collection and marketing of MFP.

The threats to forests are mainly from timber merchants and land grabbers. The apex court rightly took care of both the aspects. Besides, allowing felling of trees only in accordance with working plans approved by G.O.I., it also ensured that wood based industries are located only in notified industrial estates established at places where inspection and control on such industries consuming this "open wealth" of society would be practicable and effective. As sawmills out number veneer and ply wood mills, the movement of sawn timber out of N.E. region is allowed only through railways to ensure proper supervision and control over movement of sawn timber. This directive of apex court made possible detection of large-scale movement of alleged illegal timber in wagons at various locations in the country. The Special Investigating Team (SIT) is seized with the matter and its findings will help in curbing destruction of the forests (open wealth) by few unscrupulous elements. As a deterrent, the apex court also directed that henceforth licences of wood based industries would be renewed only in cases not found involved in any irregularity. The High Powered Committee (HPC) constituted by apex court also cancelled licences of units and imposed heavy penalty on others who were found to indulge in use of illegal timber in their units. This, it is expected, would also dissuade units from committing irregularities in future.

Besides above directives, which have direct and immediate impact on felling and consumption of timber, the apex court issued certain other directions, which have far reaching consequences. The apex court directed the state governments to ensure sufficient budgetary provisions for preservation of biodiversity and protection of wild life. It directed that timber extraction in forests irrespective of ownership, except in private plantations, shall be carried out by state agency only. In view of the situation that state governments are offering timber at lower prices, the apex court directed revision of royalty upwardly and sale of timber to intended purchasers including govt. undertaking at full market rates. This is expected to ensure participation of serious buyers only. It has been made mandatory for the Chief Secretary to review various matters concerning forest protection and development in his state at least every six months with senior forest officers. The apex court also directed that number of wood based industries will have to be determined strictly within quantity of timber which can be felled annually on sustainable basis as determined by approved working plans from time to time. If required, capacities of units located within notified industrial estates in a division are to be reduced *pro rata* to remain within sustainable levels. The PCCF is required to prepare and act upon on action plan for intensive patrolling and other necessary protective measures in identified vulnerable areas. The apex court did not spare officials too. It directed for identification of forest divisions where significant illegal felling took place and asked for disciplinary/criminal proceedings against those found responsible.

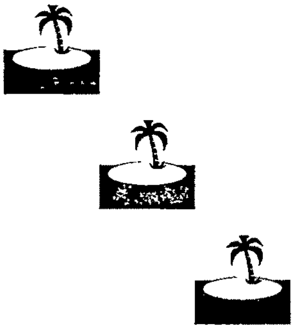
Minor Forest Produce, (MFP) including bamboo, have been excluded from such orders. The orders of apex court do not affect the local population directly dependent on usage of such MFP. For their welfare, the court has further directed state govt. to provide financial assistance in cash or kind in the form of timber only for bonafide use with the condition that such timber cannot be bartered or sold. The plantations to be raised from sale proceeds of seized timber and penalty are to be done through tribals only. The attitude of apex court and its concern for local people and states of N.E. region can be summed up by quoting appreciation of perception of MOEF made in its order dt. 15.01.98.

"Even though the proliferation of wood based industries has been the main cause of degradation of forests in N.E. states, considering the extent of forests (64% of geographical area) and the dependence of the local people on the forest resources in the region it neither feasible, nor desirable, to ban completely either the timber trade or running of wood based industries. However, their number and capacities need to be regulated, qua sustainable availability of forest produce and they are also required to be relocated in specified industrial zones. Moreover, the industrial requirements have to be subordinated to the maintenance of environment and ecology as well as bonafide local needs".

To be more specific in expressing concern for local people, the apex court desired state government to apply in case of need for modifications in its directions with alternative proposals in case local laws/customs desire.

CONCLUSION

Thus, it is evident that the directions of apex court have played important and positive role in scientific utilization of forest resources on sustainable basis and protection and conservation of forest by restricting unabated felling and diversion of forest land. These concepts were not new but were not implemented properly. What the court has said now is a judicial order and it becomes bounden duty of the states to implement these orders faithfully. The timely intervention by apex court has thus definitely helped in protecting and conserving forests inperpetuity. The State of Forest Report 1999 of FSI report that the forest cover in Arunachal has increased by about 245 sq.km. bears testimony to it. No further explanation is required to prove the point. The judgement of the Apex Court is therefore very timely. However, it is to be seen how implementing agencies prove their worth in ensuring faithful implementation of the order of apex court. If we fail, future generations shall never forgive us.



CONSERVATION OF NORTH EAST FLORA*

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ABSTRACT

The NE region of our country spread over 2,62,179 sq.km. of geographical area comprising eight states viz. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, encompasses two of the well recognised phytogeographical zones of India- the Eastern Himalayas (covering Sikkim and Arunachal Pradesh) and the Assam (all remaining states of NE region). The entire terrain in this region is essentially hilly and mountainous with varying elevations, temperature, humidity, rainfall and traversed by number of rivers and rivulets, thus forming two major river valleys – the Brahmaputra and the Barak. Such a diverse situation has favoured the rich occurrence of floral and faunal diversity in various forest types. A perusal of literature reveals that as many as 51 forest types are found in the region broadly classified under six major forest types viz. Tropical moist deciduous forests, Tropical semi evergreen forests, Tropical wet evergreen forests, Sub tropical forests, Temperate forests and Alpine forests. These forests harbour unique and diverse flora with about 8000 out of 15000 species of flowering plants, 40 out of 64 species of gymnosperms, 500 out of 1012 species of Pteridophytes, 825 out of 1145 species of orchids, 80 out of 90 species of rhododendrons, 60/110 species of bamboo, and 25 out of 56 species of canes, known in our country. Further, distribution pattern of number of species in each state of NE India reveals that Arunachal Pradesh with about 5000 species of flowering plants is the richest, followed by Sikkim with ±4500 species, Meghalaya with ±3500 species, Assam with ±3010 species, Manipur with ±2500 species, Nagaland with ±2250 species, Mizoram with ±2200 species and Tripura with ±1600 species respectively. It is worthy to note that all these species belong to about 200 plant families out of 315 recorded in India. Some of the families like Nepenthaceae, Illiciaceae and Clethraceae found here are unique in the world.

However, with the increasing human population, expansion of agriculture and tea plantation, reduced jhum cycle, clearance of forests for various purposes,

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* Invited paper presented at WOCEB-2K held from 16-18 January 2000 in Gauhati University, Guwahati.

urbanization, industrial expansion, overexploitation of natural resources and other biotic pressure including grazing by cattle and goat, have gradually depleted and threatened the existence of large number of plant species. According to the Red Data Book of Indian Plants, as many as 1500 species (10% of the total flowering plants) are endangered out of which about 800 species are reported from NE India which require immediate conservation measures. In this paper, efforts made by various agencies both Governmental and Non-governmental have been dealt in detail. Further, measures for conservation has been suggested for sustainable utilization and development of natural resources through technological innovations involving the indigenous people.

INTRODUCTION

India with a total geographical area of 329 million hectares is a store house and treasure trove of rich biological diversity both floral and faunal. The vast geographical area from Cape Camorin to Kashmir and Arunachal to Panjab has a varied topography from the seas sweeping through the central plateaus and high lands and rising to the peaks of the Himalayas with varying temperature, humidity, rainfall, vegetation and consequent rich biodiversity. There are more than 45000 plant species with about 7000 endemics and about 75,000 animal species found in this region. Hence, India is recognised as one of the 13 **"Mega Bio-diversity"** centres and one of the **"earth's biologically wealthiest nations"** in the world. There are two biodiversity rich areas within our territory, termed **as "Hot-spots"** - the Western Ghats and the Eastern Himalayas.

The North East Indian region of our country spread over 2,62,179 sq.kms encompasses eight states viz. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. These states fall under two well recognised phytogeographical zones of India - The Eastern Himalayas (Arunachal Pradesh and Sikkim) and the Assam (all other states of NE region). The entire terrain in this region is entirely hilly and mountainous starting from the plains with humid tropical conditions (river basin of the great Brahmaputra river) rising upto about 21,000 feet elevation in the Eastern Himalayas with temperate climate and snow covered peaks. The region experiences heavy to moderate rain fall, high humidity and cold winters. There are number of rivers and rivulets traversing through innumerable hill ranges treading through the rugged terrain, steep hills, valleys and draining down to form two major river systems and valleys of the region – the Brahmaputra and the Barak. All these factors have influenced the physiography and climate of the region (See Table – 1). Such a diverse situation has favoured the occurrence of rich flora and fauna in various forest types.

General vegetation and Forest Types:

Over the last one-century number of explorers, botanists and foresters have traversed through the forests of the Northeast and have reported their experiences and account of floristic diversity of the region. The Table – 2 gives some of the important contributions by various explorers and botanists in understanding the floristic diversity of the region. The list of contributors is exhaustive and all have added to the understanding of the vegetation type and floristic diversity of the region. Based on these literature and studies, the entire region can be grouped broadly under six major Forest/vegetation types as given below.

- i. Tropical Moist Deciduous Forests
- ii. Tropical Semi-evergreen Forests
- iii. Tropical evergreen Forests
- iv. Sub-tropical Forests
- v. Temperate Forests
- vi. Alpine Forests

Table – 1. Physiography and climate of N.E. Region

State	Area (Km^2)	Forest cover sq. km.	Forest cover %	Range of altitude (m)	Max. annual rainfall (mm)	Tem (°C) Min Max	Climate
Arunachal Pradesh	83743	68,847	61.54	146-7089	2000-4000	-20-28	Tropical to alpine
Assam	78438	23,688	39.15	42-1736	800-3000	6-36	Tropical to subtropical
Manipur	22327	17,384	67.87	205-2995	1400-4000	5-28	Tropical to temperate
Meghalaya	22429	15,633	42.34	90-1961	2000-12000	10-30	Tropical to temperate
Mizoram	21081	18,338	75.59	330-2140	2000-3200	12-30	Subtropical to temperate
Nagaland	16579	14,164	52.04	170-3100	1050-2000	3-27	Tropical to temperate
Sikkim	7096	3,118	37.34	200-9330	1200-6000	-04-23.3	Tropical to alpine
Tripura	10486	5,745	60.01	63-783	1200-2800	10-34	Tropical to subtropical
Total	2,62,179	1,66,917	*				

*Average forest cover recorded **54.485%.**

It is significant to note that out of nine important vegetation types of India, six of them are found in NE region only. According to the exhaustive study made by Champion and Seth (1968) there are as many as 51 distinct Forest types in the North East region as presented in table – 3. According to the Forest survey of India Report 1999, out of 2,62,179 sq.km. area 1,66,917 Sq.km. area is covered by Forests in NE Region which accounts for 62.55% of the geographical area.

Table – 2. Important floristic contributions by various authors in NE Region.

SL. No.	Year	Name of the author(s)	Title of contribution
1.	1820	Buchanan Hamilton, F.	An account of Assam with some notices concerning the neighbouring territories.
2.	1859	Lindley, J.	Contributions to the Orchidology of India
3.	1872-97	Hooker, J.D.	Flora of British India (1-7)
4.	1889	Clarke	On the plants of Kohima and Munneypore
5.	1898	Clarke	On the sub areas of British India.
6.	1906	Hooker, J.D.	A sketch of Flora of British India
7.	1934-40	Kanjilal, U.C. et al	Flora of Assam (Vols. 1-4)
8.	1938, 1942	Bor, N. L.	A sketch of the vegetation of the Aka Hills, Assam
9.	1939	Fischer, C.E.C.	The Flora of Lushai Hills
10.	1940	Bor, N. L.	Graminea. In Kanjilal et al flora of Assam Vol. 5
11.	1941	Biswas, K.	Flora of Aka Hills
12.	1942	Das, A.	Floristic of Assam – a preliminary sketch.
13.	1948	Ward, F, Kingdon	Botanical exploration in Manipur.
14.	1956	Deb, D.B.	Floristic study of Manipur, parts I & II
15.	1957	Deb, D.B.	Studies of the Flora of Manipur
16.	1958	Mukerjee, S.K.	An enumeration of the orchid of Ukhrul, Manipur
17.	1960	Ward, F.	Pilgrimage for plants
18.	1961	Deb, D.B.	Monocotyledonous plants of Manipur territory
19.	1961	Rao & Panigrahi	Distribution (vegetation types and their dominant species in Eastern India)
20.	1963	Legris	*La vegetation de L' Inde. Ecologie et flora*
21.	1968	Das & Raj Khowa	Woodlands of Assam
22.	1968	Raju, D.C.S.	Magnoliales of Assam & Sikkim Himalaya.
23.	1970-76	Rao, A.S. & Verma DM	Materials towards a Monocol flora of Assam (1-v)

SL. No.	Year	Name of the author(s)	Title of contribution
24.	1973	Kataki, S.K.	Orchids of United Khasi & Jaintia Hills.
25.		1974	Rao A.S. The vegetation and phytogeography of Assam-Burma
26.	1979	Rao & Dam	Non-Indigenous plants in the Flora of Shillong and its neighbourhood
27.	1981	Balakrishnan	Flora of Jowai and viscinity
28.	1981	Deb, D.B.	Flora of Tripura state
29.	1982	Baishya & Rao	Ferns and fern allies of Meghalaya
30.	1982	Rao, R.R.	Forest types of NE India
31	1983	Joseph and Chauhan A.S.	Namdapha Wild life sanctuary, Tirap, A.P.
32.	1984	Hegde, S. N.	Orchids of Arunachal Pradesh.
33.	1985	Haridasan & Rao	A Forest Flora of Meghalaya
34.	1986	Jamir and Rao	Ferns of Nagaland
35.	1986	Rao R.R. & Hajra P.K.	Floristic diversity of the Eastern Himalaya in a conservation perspective
36.	1988	Rao, A.N.	Conspectus of orchid flora of Arunachal Pradesh.
37.	1991	Haridasan & Deori	A list of plants not recorded in the flora of British India that are recorded from ort found in Arunachal Pradesh.
38.	1996	Chauhan, A.S	Flora of Manipur
39.	1996	Hajra, *et al*	Materials for the Flora of A.P.
40.	1996	Hajra & Verma	Flora of Sikkim

Table-3. Showing Forest types in North East India (after Champion and Seth)

IB/CI	Assam valley Tropical wet evergreen forest
IB/C2 (a, b)	Upper Assam valley Tropical evergreen forest
IB/C3	Cachar tropical evergreen forest
I/EI	Cane brakes
I/E2	Wet bamboo brakes
I/2SI	Pioneer Euphorbiaceous scrub

2B/CI (a.b)	Assam valley Semi-evergreen forest
2B/CI/IS1	Sub Himalayan high alluvial Semi evergreen forest
2B/CI/IS2	Syzygium parkland
2B/CI/2S2	Eastern alluvial Secondary semi evergreen forest
2B/C/2S3	Sub-Himalayan Secondary wet mixed forest
2B/C2	Cachar Semi evergreen forest
2/E3	Moist bamboo brakes
2/2SI	Secondary Moist bamboo brakes
3C/C1 (a,b.c)	Very Moist Sal forest
3C/C2 (d)	Moist plains Sal forest
3C/C2DSI	Moist Sal savannah
3C/C3 (b)	East Himalayan moist mixed deciduous forest
3C/C3/2SI	Northern Secondary moist mixed deciduous forest
3C/C3/2S2	Secondary Euphorbiaceous scrub
3/ISI	Low alluvial Savannah woodland
3/IS2 (a.b)	Eastern Hollock forest
4C/FS2	Sub Montane hill valley swamp forest
4C/FS3	Creeper swamp forest
4D/SSI to SS5	Tropical seasonal swamp forest
4D/2S2	Eastern wet alluvial grassland
4D/RSI	Raiparian fringing forest
5/IS2	Khair Sissu forest

8B/C2	Khasi Sub tropical hill forest
8B/DBI	Assam Sub tropical hill savannah woodland
9/C2 (8B/2SI)	Assam Sub tropical pine forest
9/C2/DSI	Assam Sub tropical pine savannah
IIB/CI (a,b,c)	East Himalayan wet temperate forest
IIB/C2	Naga hills wet temperate forest
12/C3 (a,b)	East Himalayan moist Temperate forest
12/EI	Cypress forest
12/DSI	Montane bamboo brakes
12/ISI	Alder forest
12/2SI	Low level Blue pine forest
13/C6	East Himalayan dry Temperate coniferous forest
13/C6/EI	Larch forest
13/C7	East Himalayan dry juniper/birch forest
13/ISI	Hippophae/Myricaria scrub
14/C2	East Himalayan Sub alpine birch/fir forest
14/C2/2SI	Sub alpine Blue pine forest
14/DSI	Sub alpine pasture
15/CI	Birch/Rhododendron Scrub
15/C2	Deciduous alpine scrub
15/C2/EI	Dwarf Rhododendron scrub
16/CI	Dry alpine scrub
16/EI	Dwarf juniper scrub

IMPORTANT FLORISTIC COMPOSITION OF MAJOR FOREST TYPES

1. Tropical Forest :

The tropical forest belt is represented by tropical wet evergreen, tropical semi evergreen, tropical moist deciduous and tropical marsh and wet land vegetations. Some ecological factors acting upon these are the aspect, humidity, temperature, elevations etc. which are further influenced by biotic, mostly human factors. While the tropical – wet – land marsh vegetation are confined to plains that are largely seen in Assam, very rarely they could also be encountered in the foothill plains of other states. Other types of vegetation are found both in plains and hill slopes. The marsh and wet land vegetation are the most vulnerable habitat to the onslaught of human activities and disturbances. The vegetation characteristically is of tall grasses interspersed with scattered trees making it a Savanna at places. These are the ideal habitats for elephants, gaur, rhinos, wild buffaloes and numerous aquatic birds. Land reclamation and agriculture developments have drastically reduced the area coverage of these habitats. This type of vegetation is also frequently ravaged by frequent floods. Some important plant species seen in such vegetation are *Bischofia javanica, Bombax ceiba, Lagerstroemia speciosa, Salix tetrasperma, Trewia nudiflora* etc. among trees and *Melastoma, Maranta, Alpinia, Saccharum, Phrynium, Imperata, Cypress, Ipomoea* etc. among other species.

1. a. Tropical moist deciduous forests :

This type of forests are seen in the foot hills and plains where rainfall is comparatively low but summer temperature are high and are below 600 m elevation. Their peculiarity is the feature of total leaf shedding, and marked dominance of certain species like *Shorea robusta, Lagerstroemia parviflora* etc. As these forests are rich in timber resources, they are much exploited for industrial and commercial purposes. Other species of trees seen in this type of forests are *Bombax ceiba, Gmelina arborea, Adina cordifolia, Bridelia retusa, Aporusa roxburghii, Dalbergia sissoo, Toona ciliata* etc. Some areas of Assam, Garo and Khasi hills of Meghalaya have such forests. As annual forest fires are a feature, some fire hardy gregarious shrubs are the main ground flora.

1.b. Tropical semi evergreen forests :

This type of vegetation is moister and has a greater preponderance of evergreen elements with the deciduous trees. They are also more complex in structures with more layers/strata. Being richer in biodiversity these forests are also over exploited for number of forest produces of timber and non timber nature. The most important trees are *Terminalia myriocarpa, Duabanga grandiflora, Bombax ceiba, Ailanthus grandis, Canarium strictum, Acrocarpus fraxinifolius, Tetrameles nudiflora* etc. Many of them are high economic value and are used by the wood based industries.

1.c. Tropical wet evergreen forests :

In the tropical belt in high rainfall areas of Upper Assam and parts of Arunachal Pradesh in Lohit, Changlang and Tirap districts alongwith neighbouring parts of Nagaland, this unique vegetation is seen. They are perhaps the richest in biodiversity and ecologically most complex in structure.

Among the luxuriant growth of plants, are the most important and lofty trees seen are *Dipterocarpus retusus, Shorea assamica, Altingia excelsa, Terminalia myriocarpa* and many others. These are the main raw materials for the numerous Saw, Plywood and Veneer mills located in the North East region.

In general the tropical forests are richer in diversity. They are the home of many unique and endemic species of flora and fauna. It also offers shelter to many medicinal plants and other non timber forests produce such as canes, bamboos etc. Being more accessible, the tropical forests have been deforested at a much faster rate. The high fertility rate of soils makes it more vulnerable to conversions and developments. Judging from the recent trend, these forests are likely to become relic in the near future confined only to protected areas. The tropics are the source of many of our bamboos, rattans (canes) broomstick, gums, resins and fibres. The alternatives to timber based economy could be developed in sustainable exploitation of these.

1.d. Sub tropical forests :

The sub tropical forests in north east India are found in the mid hill region. They are of two types developed due to climatic conditions, mainly the rainfall. The heavy rainfall areas support the sub tropical broad leaved forests and the lesser rainfall areas harbour the pine forests. These two are distinctly different in their composition and structure. The former is richly endowed with large species diversity and a very complex structure. The main tree species are Oaks *(Quercus, Lithocarpus), Chestnuts (Castanopsis), Magnolia, Manglietia, Engelhardtia, Schima, Persea, Cinnamomum, Acer*, and many of their associates. Many species of sub –tropical forests are hard wood species and preferred for charcoal making. Comparatively their use as timber is slightly less than the tropical species due to lack of information. The humid conditions there foster the luxuriant growth of herbaceous flora, epiphytic and climbing flora amidst which are an attractive assemblage of highly priced ornamental, medicinal and aromatic plants. This types of forests are mostly known for the non timber produce rather than timber.

Contrary to this the subtropical pine forests are species poor and uniform in structure. The dominant species like pine often appear gregarious in pure patches with selected few associate, which include *Schima, Rhus, Engelhardtia, Rhododendron*, etc. These types of forests will only have a seasonal herbaceous flora and scanty epiphytic representation. Pine forests are mostly exploited for timber and the resin.

2. Temperate forests :

States with higher altitudes like Arunachal Pradesh and Sikkim, have Temperate forests above sub tropical zone. Similar to sub-tropical zone, there are two types of forests: (1) broad leaved forest and (2) coniferous forest. Though the broad leaved forest has a reasonably rich species diversity, Maple (*Acer*), Oaks, *Sorbus, Rhododendron*, are some of the few common and dominant species with dense subcanopy structure. Due to the extreme cold conditions prevailing over here, the plants have adaptations suiting to it. This is a zone of importance as it harbours some of our important non timber forest produce like medicinal plants, aromatic plants, dyes etc.

Quite different from this is the temperate conifer forest which are dominated by conifers that grow gregariously. In their appearance, they may show definite succession. The main species are *Tsuga, Abies, Larix, Picea, Cupressus, Juniperus* etc. Under these conifers shrubby flora is very prominent. Presence of bamboos is a unique feature here. Here also timber and the non timber forest produces are the important resources.

3. Alpine forests :

This type of vegetation which is seen at the higher elevations above 3500 m MSL, is very characteristic due to the absence of tree elements. The plants are herbaceous or dwarf shrubs with many adaptations to tide over the extreme cold conditions prevailing over there. Since these areas remain under snow during the winter, the plants need special adaptations for survival in such areas. Another feature is the gregarious growth and profuse flowering of brightly coloured flowers seen over here. This vegetation consists of many high altitude medicinal plants which are very important and unique to this region, as found in Arunachal Pradesh, Sikkim and in a pocket of Nagaland. *Rhododendrons, Primulas, Polygonums, Salix, Heracleum,* and many members of *Polygonaceae, Asteraceae, Lamiaceae, Apiaceae* are the main species growing over here. Grazing by yaks is an important factor that is acting upon the vegetation in the alpine areas. Another important factor is collection of medicinal herbs in large quantities by local people. Many species have become endangered or threatened due to this exploitation, which at times is done without any concern for regeneration.

Apart from the above broad categories of vegetation, each of this have many sub types based on local conditions. Further, the ecological disturbances in each of these results in secondary types of forests evolved to suit the climatic conditions and are much inferior and different in species compositions. Grass lands and bamboo forests are secondary in nature. Bamboos have their own role in preserving the ecology and economy of the hills. Generally bamboos grow gregariously after the shifting cultivation and such large scale deforestation. The most common bamboos in north east India are *Dendrocalamus hamiltonii, Melocanna baccifera, Pseudostachyum polymorphum, Bambusa pallida, Phyllostachys bambusoides, Arundinaria spp. and Chimonobambusa callosa.*

The rolling grassland particularly of high altitudes are maintained at a successional stage due to human interference mainly for grazing purpose. The annual fires given here are mainly for fresh blades to provide fodder to the cattle.

The secondary forests in lower altitudes are composed of trees like *Macranga, Mallotus, Glochidion, Callicarpa, Saurauia, Rhus,* etc. alongwith some obnoxious weeds.

The people inhabiting the region depend upon the biodiversity at different levels and extent based on the economy and accessibility. It is worth taking a look at the different aspects of human interaction on biodiversity. These could be grouped as biodiversity for sustenance, biodiversity as economic resource and biodiversity for affluence. The main factors that act upon these are the people, their economic conditions, education level and cultural aspects.

4. Floristic diversity and distribution :

A perusal of floristic diversity of the region reveals that out of about 15,000 species of flowering plants known in India, 8000 species are found in NE region only which amounts to about 53% of the total flora of our country. Similarly, the region harbours 40 out of 64 species of Gymnosperms, 500 out of 1012 species of Pteridophytes, 825 out of 1145 species of orchids, 80 out of 90 species of Rhododendron, 60 out of 110 species of bamboo, 25 out of 56 species of canes known in India. Further, the distribution pattern of number of species in each state of NE India reveals that Arunachal Pradesh with about 5000 species of flowering plants is the richest, followed by Sikkim with ± 4500 species, Meghalaya with ± 3500 species, Assam with ± 3010 species, Manipur with ± 2,200 species and Tripura ± 1600 species respectively (Table – 4).

It is worthy to note that all the known species in NE Region fall under 200 families out of 315 known and recorded in India. Top 14 dominant plant families of the region are : Poaceae, Orchidaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Asteraceae, Cyperaceae, Lamiaceae, Scrophulariaceae, Acanthaceae, Euphorbiaceae, Rubiaceae, Urticaceae and Zingiberaceae (Table –5)

Table – 4 : Distribution of species of flowering plants in each state of NE Region.

Name of state	Geographical area (Sq. Kms.)	Population (Human)	No. Flowering plant species	Recorded Forest cover %
Arunacha Pradesh	83,743	864,558	5000	61.54
Assam	78,438	22,294,562	3010	39.15
Manipur	22,327	1,826,114	2500	67.87
Meghalaya	22,429	1,760,626	3500	42.34
Mizoram	21,081	686,217	2,200	75.59
Nagaland	16,579	1,215,573	2250	52.04
Sikkim	7,096	4,03,612	4500	37.34
Tripura	10,486	2,744,827	1600	60.01
Total	**2,62,179**	**3,07,02,673**	**±8000**	**54.485 (average)**

Some families represented in India by a solitary genus with one or two species having evolutionary significance are known from the N.E. Region. These are Nepenthaceae, Illiciaceae, Clethraceae, Turneraceae, Tetracentraceae, and some others represented by *Nepenthes khasiana* (The Khasi hill pitcher plant), *Illicium griffthii* (Lissi of Bomdila, Arunachal Pradesh), *Clethera monostachya* (from Eagles Nests, Arunachal Pradesh) *Tetracentron sinensis* (from Melinja, Lohit district, Arunachal Pradesh) respectively.

The region is particularly abundant with orchids, represented by 825 species, Rhododendrons 80 out of 90 species, *Hedychium* 20 out of 35 species, reported from India. Bamboo, cane and number of medicinal plants are also found in the region. There is also rich endemism and disjunct distribution found amongst plant species and some of them are rare and endangered as well (Table -6).

Table – 5 : Name of the dominant families with number of species in NE Region in comparison to India and world.

Sl. No.	Name of family	NE Region species/ genera	India species/genera	World species/genera
1.	Poaceae	160/500	240/1100	620/10000
2.	Orchidaceae	145/825	167/1200	760/20000
3.	Fabaceae	50/200	100/750	482/12000
4.	Caesalpiniaceae	11/42	23/801	52/2800
5.	Mimosaceae	10/35	15/75	56/2800
6.	Asteraceae	25/70	137/710	900/13000
7.	Cyperaceae	14/175	21/350	90/4000
8.	Lamiaceae	30/95	65/380	180/3500
9.	Scrophulariaceae	15/35	60/350	220/3000
10.	Acanthaceae	25/125	70/340	250/25000
11.	Euphorbiaceae	55/160	65/340	300/5000
12.	Rubiaceae	50/170	80/280	500/6000
13.	Urticaceae	15/45	25/114	45/550
14.	Zingiberaceae	18/73	20/115	46/850

In addition to these, the region also has a good number of botanical curiosities, saprophytes, parasites, etc., some of which are highly endangered. A few of these include *Sapria himalayana*, the relative of the world's largest flower *Rafflessia, Mitrastemon yamamotoi, Rhopalocnensis phalloides, Balanophora dioica, Boschinackia himalaica* etc. which are all parasites. Saprophytic plants include *Monotropa uniflora (Chilochoca humilis), Epipogium roseum, Galeola falconerii, Burmania sp.* etc. A variety of insectivorous plants occur in the region and Meghalaya is particularly rich in this group of plants. *Nepenthes, Urticularia, Drosera* are the important genera of insectivorous plants. *Dischidia rafflessiana* an epiphytic plant with pitcher forming leaves is very rare and confined to the Dipterocarp forests of Arunachal Pradesh.

North east India is also important from an evolutionary point of view with a high concentration of primitive plants which belong to families of Magnoliaceae, Amoraceae, Tetracentraceae, Lardizabdaceae, Hamamelidaceae, Piperaceae, Myricaceae, Betulaceae etc.

Table - 6 : List of some important and unique plants of north east India

Species	Family	Status	State	Remarks
Nepenthes Khasiana	Nepenthaceae	Endemic	Meghalaya	Insectivorous
Balanophora dioica	Balanophorace	Rare	Meghalaya	Parasite
Mitrastemon yamamoti	Rafflessiaceae	Endemic	Meghalaya	Parasite
Amentotaxus assamica	Taxaceae	Endemic	Arunachal	Tree
Panax pseudoginseng	Araliaceae	Endemic	Meghalaya	Medicinal herb
Sapria himalayana	Rafflessiaceae	Rare, Endemic	Arunachal	Root parasite
Helwingia himalaica	Helwingiaceae	Rare	E. Himalaya	Shrub
Paphiopedilum insignis	Orchidaceae	Rare	Mizoram	Ladies slipper
P. venustum	Orchidaceae	Rare	Meghalaya, Arunachal	Ladies slipper orchid
Elaecarpus ganitrus	Elaeocarpaceae	Religious	Arunachal, Assam	Rudraksh tree
Platycerium	Platyceraceae	Rare	Manipur	Staghorn fern
Ixonanthus khasianus	Ixonanthaceae	Rare	Meghalaya, Arunachal	Tree
Plectocomia assamica	Arecaceae	Rare	Arunachal	Giant cane
Gastrodia exilis	Orchidaceae	Rare	Meghalaya	Saprophyte
Podophyllum hexandrum	Podophyllaceae	Rare	Arunachal	Medicinal herb
Coptis teeta	Ranunculaceae	Endemic	Arunachal	Medicinal herb
Livistona jenkinsiana	Arecaceae	Rare	Nagaland, Arunachal	Palm
Renanthera imschootiana	Orchidaceae	Rare	Nagaland	Red Vanda
Dischidia rafflesiana	Dischidiaceae	Rare	Arunachal	Pitcher leaved herb
Cymbidium macrorhizon	Orchidaceae	Rare	Arunachal	Saprophytic
Tetracentron sinensis	Tetracentraceae	Rare	Arunachal	Vessel less angiosperm

Species	Family	Status	State	Remarks
Boschniakia himalaica	Orobanchaceae	Rare	Arunachal	Root parasite
Panax sikkimensis	Araliaceae	Rare	Arunachal	Medicinal herb
Edgeworthia gardeneri	Thymacliaceae	Rare	Arunachal	Currency paper
Albizia arunachalensis	Mimosaceae	Endemic	Arunachal	Tree
Monotropa uniflora	Monotropaceae	Rare	Meghalaya, Arunachal	Saprophyte
Illicium griffithii	Illiciaceae	Rare	Arunachal	Star Anise
Gnetum gnemon	Gnetaceae	Rare	Nagaland, Arunachal shrub	Gymno sperms
Epipogum sessanum	Orchidaceae	Endemic	Arunachal	Saprophyte
Psilotum sp.	Plitosaceae	Rare	Arunachal	Fern
Sassaurea obvellata	Asteraceae	Rare	Arunachal	Brahma kamal
Rhododendron tawangensis	Ericaceae	Endemic	Arunachal	Tree
Vanda coerulea	Orchidaceae	Endemic	Meghalaya, Nagaland	Blue Vanda
Stylidium kunthii	Stylidiaceae	Endemic	Meghalaya	Herb
Meconopsis betonicifolia	Papaveraceae	Rare	Arunachal	Yellow poppy

Apart from these. there are many important wild relatives occurring here. Prominent among them are Citrus, Taro, Peas, Banana, Sugar cane, cereals etc. Out of about 250 species of cultivated plants, about 200 species are found in NE India only.

DEPLETION OF FLORA

A. Causes :

Since time immemorial, these plant resource have sustained large number of ethnic communities inhabiting this area influencing the life and lore of the people with rich culture, traditions, ethos and indigenous knowledge systems (IKS), for conservation and sustainable use of plant resources. However, with the increasing population (see table-4), unhindered immigration, expansion of agriculture, tea and other plantations, traditional jhumming or shifting cultivation, clearance of forests for various purposes, urbanisation, Industrial expansion, over exploitation of natural resources and other biotic pressures such as grazing by cattle and goat, cutting of timber and fuelwood, collection of rare and ornamental plants for trade, collection of medicinal plants, cane, bamboos and other minor forest produces. have gradually depleted and threatened the existences of large number of plant species. Soil erosion, floods, land slides and forest fire have added to the problems. Land expansion and urbanisation have taken a toll of valuable and unique land and aquatic flora and ecosystem. Large scale exploitation of *Dipterocarpus macrocarpus (Hollong), Shorea assamica, Taxus buccata, Cephalotaxus*, etc. have been reduced and now they are highly threatened. Similarly, the most exploited and highly endangered ornamental family- Orchidaceae, which is one of the dominant flowering plant families in the region, is facing a threat in its natural habitat. A perusal of distribution of number of species of orchids in NE Region (Hegde 1999) reveals that out of about 850 species, ± 187 are endemics, 108 endangered or threatened, 18 extinct or nearly extinct. The famous lady's slipper orchids *(Paphiopedilum)*, blue vanda *(V. coerulea)* and red vanda *(Renanthera imschootiana)* once abundant in the region are facing a threat to their survival due to over-exploitation by the unscrupulous traders and unabated forest destruction.

B. Status :

According to IUCN reports nearly 10% of the flora in the world are endangered and threatened for extinction. An assessment of endangered status of the various plant species in NE Region by the Botanical Survey of India, reveals about 300 species are endangered needing immediate conservation measurers; while equally the same number of species are vulnerable if remedial measures are not taken. The craze and greed for possessing the rarest of the plants uncontrolled and harvesting of natural forest stands of timber species for commercial purposes have aggravated the situation reducing the forest cover significantly. According to remote sensing satellite (IRS-IB) data (1997), there is a loss of 5,482 Sq. Km of forest cover in India and 523 Sq.km in NE region only between 1993 and 1997. However, the State of Forest Report 1999 by Forest Survey of India indicates an increase in the forest cover of the country to an extent of 3,896 sq km. and the loss of forest cover in the North-Eastern region shows declining trend with only (–) 278 Sq. Km. net change/loss (Table - 7). This obviously warrants *in situ* and *ex situ* conservation of natural genetic resources for future use.

Table -7. Forest cover in North east region (in Sq.km)

State	Assessment				Total Change
	1993	1995	1997	1999	
Arunachal	68,661	68,621	68,602	68,847	+186
Assam	24,508	24,061	23,824	23,688	-840
Manipur	17,621	17,558	17.418	17,384	-237
Meghalaya	15,769	15,714	15,657	15,633	-136
Mizoram	18,697	18,576	18.775	18,338	-359
Nagaland	14,348	14,291	14,221	14,164	-184
Sikkim				3,118	-
Tripura	5,538	5,538	5,546	5,746	+208
Net change					-278

CONSERVATION

Although man is a part of the ecosystem, knowingly or unknowingly, he has been responsible for the depletion and degradation of his own environment - flora, fauna and ecosystem as a whole. Compared to the population size of other organisms on earth like insect, arthropods, mollusks etc. humans are too less in number; but the damage done to the planet earth and our biosphere is immense. *Homo sapiens* is single species whose consumption of biological and other natural resources is tremendously high causing irreparable damage to our environment. Unless timely action is taken, the planet earth would be rendered barren, devoid of biological diversity and activity, thus leading for our own downfall.

Realizing thus the importance of conservation of flora, there have been consistent efforts to conserve forests and flora, right from Vedic period. During King Ashoka's period, for the first time Abhayaranyas were set up to conserve the forests. Subsequently, during British time game sanctuaries were created in the last century. Since then, many conservation efforts have been made in this direction some of which are,

1. Prohibition of illegal collection/harvesting of forest resources through legislation.
2. Creation of protected area networks by establishing Wild life Sanctuaries, Biosphere Reserves and National Parks for *in situ* conservation.
3. Inventorisation of plant resources and assessment of their distribution and status.
4. Establishment of Botanic Gardens for *ex situ* conservation.
5. Creation of awareness.

1. Conservation through legislation :

In order to conserve and regulate the removal and consumption of bioresources, governments have promulgated laws. The land mark legislative Acts in this direction are :

i. The Indian Forest Act, 1927
ii. The wild life (Protection) Act, 1972.
iii. The Forest Conservation Act, 1980.

According to the National Forest Policy of 1952, 33% of the geographical area should be brought under the forest cover in the plain areas and 66.6% in the hill areas of our country, yet, the situation has not improved. The recent intervention of Honourable Supreme Court has certainly made some dent in strengthening the laws and conservation of bio-resources and ecology. In addition to these national law enforcement, India is a signatory to some of the International laws and conventions such as Convention of International Trade in Endangered Species of flora and fauna (CITES), Convention on Biodiversity (CBD), etc.. Under CITES all trade of endangered species is regulated.

Under CITES regulations, 14 taxa have been brought under Appendix-I & III. Accordingly, under PUBLIC NOTICE 47 "ITC (HS) classification of Export and Items 1997 –2002" relating to export of plants, plant portions and their derivatives and extracts from the wild is prohibited. The names of the plants are given in table - 8.

Table- 8: Negative list of export of plant species

1.	Beddomes cycad (*Cycas beddomei*)	(Protected under Schedule IV of WildLife Protection Act-1972)
2.	Blue vanda (*Vanda coerulea*)	- do -
3.	*Saussurea costus*	- do -
4.	Ladies slipper orchid (*Paphiopedilium* species)	-do -
5.	Pitcher plant (*Nepenthes Khasiana*)	- do -
6.	Red vanda (*Renanthera imschootiana*)	- do -
7.	*Rauvolfia serpentina* (Sarpagandha)	
8.	*Ceropegia* species	
9.	*Frerea indica* (Shindal Mankundi)	
10.	*Podophyllum hexandrum* {(emodi) Indian Podophyllum}	
11.	*Cyatheaceae* species (Tree Ferns)	
12.	*Cycadaceae* species (Cycads)	
13.	*Dioscorea deltoidea* (Elephant's foot)	
14.	*Euphorbia* species (Euphorbias)	
15.	Orchidaceae species (Orchids)	
16.	*Pterocarpus santalinus* (Red Sanders)	
17.	*Taxus wallichiana* (Common Yew or Birmi leaves)	
18.	*Aquilaria malaccensis* (Agarwood)	
19.	*Aconitum* species	
20.	*Coptis teeta*	
21.	*Coscinium fenestrum* (Calumba wood)	
22.	*Dactylorhiza hatagirea*	
23.	*Gentiana kurroa* (Kuru, Kutki)	
24.	*Gnetum* species	
25.	*Kampheria galenga*	
26.	*Nardostachys grandiflora*	
27.	*Panax pseudoginseng*	
28.	*Picrorhiza kurrooa*	
29.	*Swertia chirata* (Charayatah)	

Under IUCN, Species Survival Commission (SSC) having Species Specialist Groups, throughout the world, helps in assessing and monitoring the status of species in their natural habitat and suggests strategies and measures for suitable conservation measures to be taken by various nations.

2. Creation of Protected Area Networks (PAs)

Further, under the provisions of the Wild Life (Protection) Act 1972 each State has established Protected Area network by declaring Wild Life Sanctuaries and National Parks. Accordingly, in India today, there are 23 Tiger Reserves, 87 National Parks and 485 Wild Life Sanctuaries spread over all the states of Indian territory covering an area of 1,56,006 Sq.Kms which amounts to 4.75% of the total geographical area of our country. In the NE States there are 55 Protected areas spread over 16,057.75 Sq.kms which accounts for 6.11 % of the total geographical area of N.E. Region (Table- 9)

Table- 9: Showing number of Protected Areas (Pas) and distribution of plant species in NE States.

State	No. of P.As	Areas of P.As (Sq.Km)
Arunachal Pradesh	13	9582.68
Assam	15	2113.59
Manipur	3	266.65
Meghalaya	4	301.68
Mizoram	6	884.00
Nagàland	4	226.43
Sikkim	6	2049.10
Tripura	4	603.62
Total	**53**	**16027.75**

However, for a meaningful conservation of biological resources, there is a need to increase the total protected areas (PAs) network to at least 12% of the country's land cover, as against the minimum prescribed 4.6%. According to Tiwari (1997) the best-covered protected areas in the N.E. Region are under Sikkim (28.87%) and Arunachal Pradesh (11.44%). Yet, it is significant that large number of rare and endangered plants found in this region fall outside the PA network thus warranting both *in situ* and *ex situ* conservation.

1. Inventorisation of plant resources and assessment.

Hooker's Flora of British India (1872-1897) is the voluminous inventory and compendium of plant resources that include flora of N.E. India also. Subsequently, there have been number of statewise reports. With the activities of Botanical Survey of India at Shillong in the post-independence era, systematic works have been done and assessment of status of various species carried out. Similarly, survey and explorations carried out by various Universities, CSIR, ICAR, FSI, NBPGR, State Forest Departments, and Remote Sensing agencies have helped us to know the alarming position of depletion of plant resources and to initiate all possible conservation measures and to raise a global concern on the issues of depleting plant genetic resources world over.

2. *Ex situ* conservation in Botanic Garden, Arboretums and plantation

Species that occur outside the protected areas (PAs) are often exposed to threat. Such plants require a safe home in other than their natural habitat – i.e. in Botanic Gardens, Arboretums, and even by cultivation in the private gardens and plantations. Species of cultivated plants find their safe homes in the farm yards, plantations and agricultural field and thus are conserved as our genetic resources. But, other species of medicinal, ornamental and commercial usage require protection. Botanical Survey of India maintains germplasm gardens at Shillong (Barapani), so also NBPGR, ICAR, Universities and State Departments thereby helping conservation of plant species. However, there is a need to develop more of such botanic gardens to conserve our plant resources for studying their utilities for future benevolence.

3. Creation of Awareness :

Conservation is closely linked with human activity who reaps the benefit by harvesting, consuming and utilising the resources. However, in the absence of knowledge on the importance of conservation of plant resources in sustainable manner, people tend to consume excessively leading to depletion and loss of genetic resources. Many a species/germplasm of commercial importance originally occurring in the tropics are in the hands of developed nations today. For instance, the orchid trade today, is a multimillion-dollar business elsewhere in the world. In fact, germplasm of latest hybrids of commerce like, Cymbidiums, Paphiopedilums and Vandas have gone out from this part of the country and have contributed in the development of newer hybrids of commerce. Further, our plant materials are being patented by the developed nations. Today, we have to look for other nations for assistance inspite of the fact that we have very rich plant genetic resources. Hence, there is a need to create awareness amongst the common man, farmers and villagers on the importance of conserving our flora, forests and environment. In this regard, activities of the Government and Non-government organisation must be taken as a coordinated effort to create awareness amongst the general public. In fact, WWF- India, CEE (North east) and State Forest departments have been carrying out campaigns in the form of Van Mahotsava, World Environment Day celebrations, conduction of workshops and training. However there is a need to high-lighting the ill effects of depletion of our plant resources and beneficial effects of their proper conservation. The United Nation Development Programme (UNDP) have chalked out strategies of human development through sustainable consumption or utilization of our natural resources on the principle of **"Think Globally, Act Locally"**. Similarly, consumption of our natural resources must **be need based, not greed based.** Technological innovations based on indigenous knowledge system to suit the local needs and adoption of biotechnological approaches, making use of latest information technologies for sustainable development, hold the keys for conserving plant resources in the North East region.

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DO BIODIVERSITY INDICES APPLY TO FOREST MANAGEMENT

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ABSTRACT

With the new emphasis in land management, biodiversity analysis has become a key factor of assessment for forest managers for making their plans and decisions. Deciding which measures of biological diversity assessment are to be used, land managers need to understand why biodiversity is valued, which components feasible. In this paper, the principal indices of biodiversity are evaluated. Attention is drawn to the differing emphasis of biodiversity indices - species richness, heterogeneity and evenness and to how these differences address different values. Potential applications for these indices in forest management plans- including ways to use habitat models to approximate biodiversity - are also discussed.

INTRODUCTION

With the new emphasis in land management agencies on ecosystem management, attention is being paid to measure the biological diversity (biodiversity). The need for reliable, quantitative measure of a rather abstract concept should be readily apparent. Scores of biodiversity indices are used by ecologists to monitor the effects of pollution or to designate conservation areas, usually through analysis of plots too small to be practical for forest management. Each of these measures, from species richness to heterogeneity to evenness, emphasizes slightly different components of Biodiversity over others. Besides introducing confusion when choosing which index to use, the often contradictory results of these indices provide ample opportunity for their misuse.

Measuring (and managing) forest biodiversity requires and understanding of several important points or themes like (1) the need to express biodiversity quantitatively; (2) the importance of isolating the various values attached to biodiversity; (3) the relationships among the three distinct (and at times conflicting) components of species diversity-richness, heterogeneity and evenness ; and (4) the recognition of constraints of management feasibility (particularly concerning data availability) that necessitate in some instances accepting models and other approximations of biodiversity.

These themes are clearly interrelated in the quest for better understanding of what biodiversity is, why it is important. and how it can be monitored and managed. Public natural resource management planning requires many steps, with each step subject to appeal by industrial and environmental interests. To avoid expensive legal challenges and more importantly, to provide the best management, the goal of planning and management must be defined as precisely as possible in order that multiple alternatives may be evaluated as objectively as possible. As biodiversity values are being integrated into the plans for National Forests Policies and other federal lands, the need to quantify these values becomes increasingly acute (Loomis 1993). Using quantitative indices allows biodiversity objectives to be sent out clearly, and alternative plans to be evaluated definitively.

Obstacles to quantification are numerous. Some spring from a fairly simple problem:)iodiversity is often too broadly defined. Early definitions of biodiversity stressed the variety of)rganisms in other words, species diversity. More recent descriptions are much more extensive, ncorporating such elements as genetic variation within species, diversity of ecosystem "types" and ;tructural and functional components of diversity. As these definitions expand, they become less iseful for manager virtually everything in the forest is seen as indicative of "biodiversity" (McKanney *'t al.* 1994).

/ALUES AND MEASURES OF BIODIVERSITY

Humans attach to biodiversity many different values, separated here into three categories :)iodiversity as a means to an end, as a measure of environmental quality, and as an end in itself. In he first category, biodiversity is valued for its contribution to the sustainable production of goods ind services. The discovery of new medicines is an oft-cited example: Farnsworth (1988) lists more han 100 pure chemical substances extracted from plants and used worldwide for medicine.

The diversity of forest species supplies many amenities and commodities not only medicines,)ut foods, wood products, natural fibres, recreation opportunities, aesthetic benefits, ecological filtering ind more (West 1993). If the goal of biodiversity conservation is to keep intact the diverse pieces)f the supply base in order to keep these forest goods and services flowing then clearly biodiversity s valued instrumentally as a means to this end.

Predicting the chemical (and economic) potential of a particular species is, of course, difficult. t is unlikely that every plant, animal or microbe will yield new products beneficial to humans. The mplicit assumption in arguments for saving biodiversity based on commodity production, than is that)ur lack of knowledge about the number of species, their potential uses, and the future economic 'alue of those uses justifies preserving as many different species as we can.

In the second category of values, biodiversity serves as an early warning system by indicating :nvironmental damage. Biological indicators are organisms so closely tied to certain environmental onditions that their presence indicates the existence of those conditions. Pollution studies have used wide range of organisms, from lichens to aquatic fly larvae to honeybees. field mice and shrews, or biological monitoring. By allowing us assess pollution levels of environmentalist it becomes ininhabitable for all life, these indicators are like the proverbial canary in a coal mine. Moreover, here is a sense that biodiversity, in and of itself, may indicate a desirable environment. In the words)f one Forest Service researcher, high biodiversity reflects a diversity of ecological options, "the esult of abundant opportunities for different organisms to acquire and use resources". As long as iodiversity is maintained, we have evidence that these opportunities are still available in our nvironment.

While conservation arguments based on its contributions to a better life for humankind are ompelling, biodiversity is increasingly valued not for what it contributes but for what it is this is ıe third category of biodiversity values. Whether the impetus is moral, religious, philosophical, or historical, many view biodiversity as an end-in-itself, quite apart from the instrumental uses it may have in making human lives better. Philosophers and environmental ethicists ascribe "intrinsic valued" to entities that are valued as ends in themselves, rather than as the means to some other purpose. Unlike its value as a means to an end, the intrinsic value of a species is presumed to be equal to that of any other species is presumed to be equal to that of any other species. Pinon pine (Pinus edulis); though less commercially valuable than lodgepole pine (P. contorta), has no less intrinsic value. The same is true for species value as part of our natural history. The leading proponent of this historical value is E.O. Wilson, who suggests that each new species of higher organism discovered is "richer in information that a Caravaggio painting, Bach fugue, or any other great work of art" (Wilson 1985, p:701).

These three categories of value not only provide a variety of justifications for conserving biodiversity but they also suggest, because of their distinct emphasis, that different components of species diversity may be more essential depending on which values are paramount. These components include species richness, heterogeneity, and evenness.

Measures of Species Diversity

Species diversity indices have been useful in allowing ecologists to spot environmental problems and identify important areas for nature reserves (Magurran 1988). The various species diversity measures differ primarily in their sensitivity to changes in the proportional abundance of rare vs. common species. Species richness measures, which are sample counts of the number of species present in an area, are widely used because of their ease of computation. However, their ultra-sensitivity to the number of rare species present ensures that as the size of a sampling area increases (or, similarly, as the sampling effort on a given area increases), species richness increases accordingly (Magurran 1988).

Heterogeneity measures, the most well known of which are Simpson's Index (Simpson 1949) and Shannon's Index (Shannon and Weaver 1964), are less sensitive to the number of rare species present and thus to the extent of the sampling area. In these measures, diversity is the sum of the weighted proportional abundance of all species found in the sample; diversity increases as rare species become less rare or as the most dominant species become less dominant.

The third type of species diversity measures evenness measures concentrate on the distribution of species' proportional abundance, independent of the total number of species present. Models of species abundance such as the geometric series, log series, and log normal distributions are measures of evenness, as are indices, such as Pielou's statistic, which compare real diversity to a hypothetical maximum (Pielou 1975). Evenness measures are the least sensitive of the three types of sampling intensity, driven more by the proportional abundance of the most dominant species than by the number of species found.

While these three measures of species diversity have been used widely in ecological plot studies, with the exception of species richness, they have rarely been applied at larger geographic scales. One obvious obstacle to using these measures at forest scales is the amount of data collection necessary to derive, for example, a heterogeneity index for birds on a 200,000-acre forest. Instead of measuring species diversity directly, then forest managers are likely to try to gauge forest biodiversity by the performance of certain high profile vertebrate species (often threatened or endangered), or increasingly, by the patterns of landscape patches distributed across regional scales (Noss 1983). In their case, we find these efforts inadequate to address biodiversity. In the next section, we offer alternatives for forests that are based on the fine-scale species diversity measures described above.

RECOMMENDATIONS FOR FUTURE STUDY AND SPECIFIC APPLICATIONS.

The reluctance of some researchers to use species diversity measures is due to the sometimes contradictory results they can yield. Efforts to construct intrinsic diversity profiles for comparing communities arose from this phenomenon. However, as each measure emphasizes a different component of species diversity, forest managers can and ought to choose the specific measures best corresponding to the forest's values-based objectives.

Variety Equals Sustainability.

For example, in order to insure the continued production of many resources (mandated by the Multiple Use Sustained Yield Act of 1960), a U.S. National Forest must take steps to protect a varied production base of plants, animals, fungi, microbes etc. this variety is essentially species richness. If maintaining variety is set out as a management objective, then areas of greatest species richness would be appropriate areas for protection. Likewise, protecting areas rich in threatened and endangered species also focuses conservation strategy on the maintenance of a variety of species, thus protecting the forest's potential sustainability.

Because a sustainable supply of forest products may ultimately depend on maintaining genetic variety, many techniques have been proposed for enhancing the diversity of genes within a population. A similar rationale is used to suggest that conservation of individual species be prioritized so as to maximize genetic diversity. For example, this approach has been proposed in connection with conservation in the crane family (Weitzman 1993). The chief difficulty with this strategy for forest managers (apart from ethical questions about "Playing God") is the extraordinary cost and effort associated with individual species conservation, especially when critical habitat for the species lies outside the forest's boundaries.

Whether the focus is on the species level or on the genetic level, protecting sustainability means protecting rarity. From the perspective of biodiversity for sustainability, the value of any species is ultimately derived from the actual and potential products and services it provides. Thus, assuming conservation biology can keep a rare species viable long enough for the discovery of a medicine, food or unique recreational or aesthetic benefit associated with that species, the market place for this benefits will insure the species further protection. This fundamental trust in the free market system is one of the underlying (and usually unstated) assumptions behind arguments for protecting biodiversity for the sake of sustainability. Other perspectives regarding biodiversity exhibit much less trust in economics.

If biodiversity is valued less as a means to sustainability than as an indicator of environmental quality, then species richness measures are probably not appropriate. At the site level, changes in the relative abundance of species not in the overall number of species, are the first indicators of environmental degradation (Magurran 1988). Evenness measures offer greater sensitivity to environmental contamination than either richness or heterogeneity measures. (In fact, tipping off such contamination may be the only real use for evenness measures.) Other proposed site-level environmental quality measures, such as monitoring nutrient cycling rates (Noss 1990), seem to pertain less to biodiversity than to the "normal" functioning of ecosystems. While it is likely that these rates play a role in the maintenance of species diversity, documenting the nature of the role is difficult. In any event, using site level process rates as a measure of biodiversity makes little sense for forest management, again because of the huge data collection required.

In fact, most attempts to tie biodiversity to environmental quality at the forest level are problematic. For example, while indicator species have a well documented role in revealing air and water pollution (Root 1990, Tobin 1990). Their presence alone should not be equated with biodiversity. Alternatively, recent research has focused on landscape disturbance frequencies as a measure of the naturalness of managed forest how closely they parallel the corresponding historic spatial and temporal disturbance patterns (Turner et al. 1993; Reice 1994).

Biodiversity as an End: Heterogeneity Measures and Habitat Models.

Valuing biodiversity because of what it contributes to sustainability or environmental quality is certainly legitimate, but the links between means and ends are susceptible to fluctuating economic climates, cost benefit analysis and arbitrary and changeable standards of what constitutes environmental quality. Valuing biodiversity for its own sake provides a stronger, more lasting justification for the work of preserving it. Consequently, deciding which techniques best measures this value is particularly important and should be a top priority for forest management.

Maintaining biodiversity for its own sake is best accomplished via species heterogeneity measures within communities/ecosystem. More than either richness or evenness alone, heterogeneity truly reflects the effective diversity of a collection by incorporating both of these elements. This diversity has real effects in the forest, increasing the probability of inter specific encounters when exploring the forest. Further, heterogeneity measures treat all species equally and thus incorporate fully the intrinsic value of each species and of biodiversity.

Within a forest, the best way to measure species heterogeneity is to use habitat rather than population data. This approach is both more feasible (population data aren't even available for many species) and more accurate. Population numbers will vary seasonally and annually as a result of stochastic variation not necessarily because biodiversity is increasing or decreasing. Studies have even suggested that population numbers can mislead, particularly in territorial vertebrates, where better habitat is often less populated than poorer sites (Van Horne 1983).

Habitat modeling serves a dual purpose, helping managers to better understand the biology of animal species while also providing a diversity measure. A drawback of currently available habitat models, though, is that only vertebrate animals are considered: plants, insects, and fungi are excluded from analysis. The emphasis on vertebrates in habitat modeling stems from their mobility; the further an animal roams, the more necessary it becomes to identify areas (habitat) where the animal could be rather than where it is. Besides, plants and sessile invertebrates are more likely to be the focus of site level environmental monitoring efforts.

There are at least two ways in which habitat models can be used to yield measures of forest biodiversity. One is to translate acres of habitat into supportable numbers of individual animals, species by species. This is the approach of the USDA Forest Service's HABCAP (Habitat Capability) models, which link habitat to potential carrying capacity via per acre multipliers that vary with the quality (optimal, suitable, etc.) of the habitat. Coming up with the multipliers requires incorporating the relative differences between species body size, home range and territory size, social structures (herds, packs, breeding pairs, individuals) into the models.

The second way to use habitat modeling to measure biodiversity dispenses entirely with estimates of populations numbers and simply uses habitat acres (again, scales to home range size) as a stand in for population numbers. This method is preferred, partly because of the spurious connection between habitat quality and population numbers observed by Van Horne (1983) and partly because managing habitat is simply more feasible than managing animal populations.

In both cases, attention to the spatial arrangement of habitat is crucial, especially for species with large home ranges and relatively low tolerance for traversing unsuitable habitat. For example, elk (Cervus elaphus) require large blocks of contiguous habitat small, isolated patches of habitat are useless. Similarly for species with smaller ranges, like voles or salamanders (larger habitat patches) is certainly less important. Geographic Information Systems (GIS) technology has allowed for better spatial analysis of connectivity. Both the USDA Forest Service Pacific Northwest Region's HABSCAPES (Habitat Analysis of Landscapes) model and the State of California's WHR (Wildlife Habitat Relationships) system use grid-based nearest neighbour algorithms to determine whether a single pixel of optimal habitat is an isolated fragment or part of a larger clump of similarly good habitat (Mellen et al. 1994). As knowledge increases about species' ability to disperse from patch to patch through less than optimal habitat, these algorithms can be refined to accommodate this new information. For example, a spatially explicit dispersal model developed to study northern spotted owls (Strix occidentalis caurina) in Washington and Oregon (called, appropriately, OWL) represent just such a refinement.

The final key to making habitat-modeling work for biodiversity analysis is to be thoughtfully selective about which species to analyze. Technically, it is possible to evaluate habitat for hundreds of vertebrate species on every 30 meter square pixel of land in a forest to assess each species' home range and territory limits, to apply carrying capacity estimates based on this habitat analysis, and to arrive at some idea of the potential populations for each species in the forest. This would yield a static picture of vertebrate species heterogeneity, along with a hefty bill for computer time. Whereas the primary interest then must evaluate the changes in those potential populations based on different management alternative; given half a dozen such alternatives and a planning horizon of 10 to 50 years, trying to look at all species at once is probably impractical.

Selecting species that effectively "Stand in" for others (often called "management indicator species") can be helpful. However, the manager must be certain that the indicators really do represent the habitat requirements of their proxy species. In the HABSCAPES model, for example, species are grouped into "guilds" based on their home range size, serial stage preference, and dependence on contrast (edge) or homogeneous (interior forest) habitat. The habitat analysis is then run for the entire guild sharing the same preference. Another way of selecting species for analysis would be to use qualitative distinctions based on their functions in ecosystems-identifying "key stone" species, for example again being careful to ensure that solid research supports these qualitative designations.

Habitat models represent the crucial link between fine scale heterogeneity and forest scale diversity measurement. As it becomes increasingly clear that society does value biodiversity as an end in itself, expanding the use of these models and refining their applications take on a greater urgency. The limits of our ability to collect enough data to understand the current status and trend of every species determine what is feasible to manage. Using habitat models approximations of reality should help managers make the best decisions given the available data.

CONCLUSION

If biodiverstiy measures are to be useful to forest managers, they must be meaningful (both biologically and socially), measurable (quantitative and obtainable from available data), and manageable (subject to change based on human decision). Separating the many components of biodiversity, keeping in sight the reasons we value biodiversity, and recognizing what is feasible and cost effective will go a long way toward helping forest managers incorporate biodiversity into their management plans.

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MASS PROPAGATION OF *BAMBUSA BALCOOA, B. NUTANS* AND *B. TULDA* THROUGH CULM CUTTINGS

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ABSTRACT

A study on the vegetative propagation of *Bambusa balcooa*, *B. nutans*, and *B tulda* was carried out through rooting of bi-nodal culm cuttings. Different growth regulating substances i.e. indoleacetic acid (IAA), indolebutyric acid (IBA), napthaleneacetic acid (NAA), gibberellic acid (GA_3) and boric acid were used for enhancing the rooting response. Observations were recorded on rooting, sprouting and survival per cent of the cuttings periodically up to six months. Rooting and sprouting response varied among the species and treatments used. *Bambusa balcooa* gave maximum response (140-160%) followed by *B. nutans* and *B. tulda.* Cuttings made of top portion of culm rooted and sprouted better than the cuttings of middle and lower portion. Factors affecting the rooting and sprouting ability like age and part of culm used, season for multiplication, optimum treatment and results obtained are discussed in the paper.

Key words : Bamboo, culm cutting, growth regulators, propagation, rooting

INTRODUCTION

The bamboo resources are depleting at an alarming rate due to over exploitation, shifting cultivation. and forest fires etc. The situation sometimes aggravated due to gregarious flowering over large tracts. Sustained availability can be ensured only by raising bamboo plantations. Plantation efforts are constrained due to non-availability of planting stock and seeds, as bamboo has very long seeding cycle of 20 to 100 years. Even seeds are short viable often limited to few months. It is therefore, necessary to evolve appropriate technology for raising large-scale plantation of improved bamboo clumps especially when seeds are not easily available. Various methods of vegetative propagation like offset planting, rooting of culm cuttings and branch cuttings are generally used (McClure, 1966; McClure and Kennard, 1955). The success and limitations of various propagation methods of bamboos have been reviewed by Banik (1980, 1995) and Hasan (1980). Successful propagation of *B. balcooa, B. nutans, B. tulda* and other bamboo species using growth promoting substances has been reported by many workers (Adarsh Kumar *et al.* 1988; Saharia and Sen,1990; Seethalakshmi *et al.* 1983). Mass production of planting stock of *Dendrocalamus hamiltonii, D. strictus* and *B. arundinacea* has been reported by Adarsh Kumar, (1991). However, most of these reports dealt with shoot proliferation and rhizomes separation of plants raised through seedlings, culm/branch cuttings. Many reports on use of growth regulators in promoting the rooting are available, but the effect of non-auxinic substances and suitability of culm segment is almost lacking. This has been investigated in the present study. The bamboo culms are capable of proliferating themselves from nodes to produce offset planting, which has been successfully used in the present study for mass multiplication of *B. balcooa*, *B. tulda* and *B. nutans*, and results are reported herein.

MATERIALS AND METHODS

Approximately two to three years old culms of *Bambusa balcooa*, *B. tulda* and *B. nutans* were extracted from healthy 'plus clumps' growing in bamboo germplasm bank of State Forest Research Institute at Van Vigayan Kendra, Chessa. The top thin part of the culm, bearing leaves was discarded and nodal branches trimmed off, leaving 2.5 cm shoot without damaging the axillary buds. Two node cuttings (offset) were made leaving 1",2", 3" and 4 inch on both side beyond the node using hacksaw or smooth knife to prevent splitting of culms. Cuttings with healthy axillary buds were selected and a hole (21.5 cm) in the center of internode was made taking care that both nodal buds lie in horizontal and parallel to the ground plane. The stock solutions of various concentrations of the growth regulators i.e. indoleacetic acid (IAA), indolebutyric acid (IBA), napthaleneacetic acid (NAA), gibberellic acid (GA_3) and boric acid were made and 100 ml solution was pored into culm cavity (Table-1). The opening was closed by tying a polythene strip. Ten culm cuttings in three replicates under each treatment and an additional set as control were used.

The nursery beds of 10 X 1 m size were prepared one month prior to planting and drenched with 0.01% Aldrin (30 EC) and 0.05 % Bavistin (WP) to prevent termite and fungal attack. Treated cuttings were placed horizontally in trenches, ensuring that the opening faced upwards and covered with uniform layer of soil. The beds were irrigated daily and shaded with thatch to prevent scorching by sun. Sprouted cuttings were regularly observed for rooting response. Sprouting and rooting of each node of the bi-nodal cutting was recorded individually against the total number of culm cuttings planted per treatment. Therefore total percentages exceeded more than 100 wherein both the nodes rooted successfully. The rooted cuttings finally survived are reported in Table 1. Sprouted and rooted cuttings were uprooted after five to six months, separated from both nodes and transplanted in field.

RESULTS AND DISCUSSION

The multiple shoots sprouted from nodal buds of culm cuttings within three weeks of planting and this was followed by development of adventitious roots. Profuse rooting was followed by rhizome genesis and fast growth of shoots at later stage. Rooting response was lesser than sprouting of shoots as some of the shoots died without initiation of roots. The data on successful rooting and sprouting of three bamboo species to various treatments is shown in Table – 1.

Among the four growth regulators used for *Bambusa balcooa* the 200 PPM Boric acid treatment induced maximum i.e. 142 to 160 % rooting and sprouting. This was followed by 110 to 98% response under the 50-100 PPM, IAA treatment. The IBA and GA_3 had comparatively lesser effect by giving rise to maximum of 80 and 62 percent response through 100 PPM treatment, respectively. However, it is much higher than report of Saharia and Sen (1990) and Stapleton (1987) for the same species. Particular trend or significant difference due to the varying time of propagation was not observed. However, the cuttings made from top portion of the culms gave better response in comparison to the cuttings of the middle and basal segment of the culm. This can be attributed to the availability of more auxins, carbohydrates and juvenility of buds which is more responsive to propagation and therefore induced more and early sprouting of shoots and roots. However, mortality rate was higher than the cuttings of basal segment.

Bambusa tulda showed comparatively poor rooting and sprouting ability. In general the average response under various treatments was 23.23 percent with lesser deviation of 15.10 as compared to other species. A maximum of 62 percent response was obtained through 200 PPM boric acid treatment in the month of September. The segment of internode left beyond both the nodes of the cutting had positive effect on rooting and sprouting ability to a limited extent. An increasing trend and maximum response was obtained upto those cuttings had 3 inch segment of internode beyond both the nodes. This may be due to the more and prolonged supply of nutrients and hormones from additional segment of culm to the growing shoots until the absorption of nutrients through roots, translocation and full production of metabolites comes in to effect. Moreover, it reduced the drying effect of both cut ends to the growing shoots. However, decreased response of the subsequent treatment is not in agreement of this fact. The varying time of propagation did not show any particular trend and difference in rooting and sprouting response which may be due to less change in environmental conditions during this period.

In case of *B. nutans*, both control as well as 200 PPM boric acid treatment gave high rate of rooting and sprouting which shows that it is quite responsive to vegetative propagation irrespective of the growth regulator treatments. This is in agreement with the earlier report wherein 64.5% rooting has been obtained without growth regulator treatments (Stapleton, 1987). Cuttings made from top of culm gave maximum response (110 per cent) which is significantly higher than cuttings of the middle and basal part of culm. This is again in conformity with the response obtained for *B. balcooa*. However, according to Bohidar (1989) three noded cuttings of *B. nutans* taken from 1/3 basal or middle segment of one year old culm and from lower 1/3 portion of two and three year old culm showed best survival. This may be due to more tolerance against drying in lower part of culm. While top segment of culm has better rooting and sprouting ability but have less desiccation tolerance and survival rate. If watered properly it can yield better results as is evident from the present findings. Propagation during October was found better than December may be due to increased availability of metabolites and favorable environmental conditions.

Auxinic and non-auxinic substances promoted sprouting and rooting substantially are in agreement of the reports of many workers (Adarsh Kumar *et al.* 1988, Seethalakshmi *et al.* 1983). However, proper balance of the nutrients and auxins is pre-requisite for rooting (Nanda *et al.* 1972, Gurumurti and Nanda, 1974) and this is evident from the fact that different segment of a culm had differed in rooting ability. According to the Saharia and Sen (1990) the two year old cuttings of *B. arundinacea, B. balcooa, B. pallida and Melocanna baccifera* showed higher percentage of success than one or three years old cuttings. In addition to it the morpho-physiological status of parent plant from which the cuttings are obtained is paramount importance (Nanda and Anand, 1970; Adarsh Kumar, 1990). If the clump had already reached near to maturity and flowering than prolonged availability of the material can not be ensured. Hence, for raising plantations on large scale the youngest clumps of different flowering period should be preferred which will give better rooting, vigorous growth and uniform sustained supply of material. Several factors like size of cutting and its position on the culm, season of taking and planting determine the rooting ability and its survival. The local people of Arunachal Pradesh harvest the bamboos for domestic use at a particular time according to the cycle of moon when it gives maximum durability and resistance to pest. It may be due to the changes in biochemical composition of the culms during that short period. Besides this, the clonal propagation response varies among the clones, species and in environmental conditions as is evident from the results of these three species. The findings on suitability of the particular segment and size of culm cuttings with use of easily available non-auxinic substance in present investigation will help on large scale propagation of bamboos as well as utilization of unused segment of culms for other purpose.

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Table 1. Rooting and sprouting response of three different species of bamboos

Species	*Bambusa balcooa*		*Bambusa tulda*			*Bambusa nutans*		
Treatment (PPM)	Rooting & sprouting (%)		Treatment (PPM)	Rooting & sprouting (%)		Treatment (PPM)	Rooting & sprouting (%)	
	September	October		August	September		October	December
Control	30.0	27.0	Control	12.0	10.0	Control - B	67.0	40.0
IAA - 20	90.0	82.0	Boric-100,1"	12.0	20.0	M	78.5	52.0
50	110.0	98.0	Acid. 2"	28.0	30.0	T	102.0	57.5
100	100.0	96.0	3"	24.0	50.0	Boric-200, B	73.5	68.0
200	70.0	98.0	4"	15.0	20.0	Acid. M	87.5	85.0
IBA - 20	40.0	81.0	Boric acid 200	15.0	36.6	T	110.0	106.0
50	80.0	64.0	200, 1"	12.0	10.0			
100	80.0	73.0	2"	14.0	20.0			
200	80.0	80.0	3"	20.0	62.0			
GA_3 - 20	40.0	34.0	4"	10.0	10.0			
50	60.0	47.0	IAA- 100, 1"	15.0	20.0			
100	60.0	62.0	200, 1"	23.5	22.0			
200	30.0	43.0	NAA-100, 1"	18.5	10.0			
Boric-100B	80.0	40.0	200, 1"	32.0	25.0			
Acid-100M	90.0	63.0	GA_3-100, 1"	13.0	10.0			
100T	142.0	160.0	200, 1"	17.5	16.0			
200B	90.0	100.0						
200M	96.0	100.0						
200T	110.0	140.0						
Control	28.0	20.0						
Mean	75.30	75.40		17.59	23.23		86.42	68.08
SD	30.74	36.11		6.35	15.10		16.77	24.01
SE	6.87	8.07		1.58	3.77		6.84	9.80

Abbreviations: B, M and T- Basal, middle and top segment of the culm used for making cuttings
1", 2", 3" and 4 inch segment of internode left beyond each node alongwith cutting.

BAMBOO BASED SOCIO ECONOMIC REVOLUTION IN RURAL SOUTH EASTERN CHINA

— Relevence to North East India

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ABSTRACT

China has one of the richest diversity of bamboos in the world. These resources have been extensively used by bamboo based industries in that country and has resulted in marked economic development particularly in rural areas. Utilisation of bamboo has many more advantages. The author has recently visited some of the bamboo growing areas in China. The paper is based on his experience there. He feels that the Chinese pattern of bamboo utilization has great relevance to north east India which is discussed in the paper.

INTRODUCTION

Bamboo is a very important non-timber forest produce which is quick growing and has short rotation. It has good regeneration and economic values Various species of bamboos are largely distributed in the tropics and subtropics around the world and play a prominent role in the economy of developing countries in Asia, Latin America and Africa. Evidently there are good social benefits in bamboo sector which is resource – dependent and labour intensive one. It can provide considerable jobs and ecological security in rural areas. Incidentally when the forest areas in the world are drastically reducing yet the bamboo groves increased by three folds each year (Lei Jiafu 2000). China has one of the largest bamboo resources in the world with 39 genera and over 500 species of bamboos (Fu Maoyi 1999). Based on their nature of growth they are either monopodial- single stem bamboos or sympodial- clump forming bamboos (Ma Naixun 2000). They are distributed widely from near sea level to very high altitudes in the temperate and even alpine habitats (Zhu Shilin 1994). These are used in a variety of ways such as edible shoots, industrial products like sticks, mats, ply, floor and panel boards, handicrafts. etc. China's experience in utilising bamboos is remarkable. They have been able to change the economy of bamboo rich countries to enviable heights using bamboo resources. There are lot of similarities that China has with our region. Their experience has great application value in this region. I had recently a chance to visit some of the bamboo growing areas in that country. My impression on the bamboo sector in China is shared in the following paragraphs.

BAMBOOS

Bamboos are tall grasses belonging to the family Poaceae to which Rice and Wheat belongs. World over there are about 70 genera and over 1200 species of bamboos. Nearly 50 percent are seen in China. Out of the 500 species in China only 100 are currently used for developmental activities. It is worth comparing that figure with our country which has 23 genera and 120 species (Biswas1998, Seethalakshmi & Muktesh 1998). In India, north east region has a great diversity and culture of bamboo (Haridasan *et al.* 2000). If we take into consideration the cultivated species along with wild ones, then in this region there are over 17 genera and 89 species which amply illustrates the richness. Similarly the south east China proximal to our region has comparatively higher concentration of bamboos. Like in north eastern states in India they too utilise bamboos in a variety of ways both traditionally and industrially. According to growth habit bamboos are mainly of two groups the monopodial or non- clump forming types or in other words the single stem bamboos. For example the Apathani bamboo (*Phyllostachys* sp.) cultivated by the Apathanis in Ziro valley and the Bojal bamboo (*Schisostachyum polymorphum*) occurring near riverine plains Muli (*Melocanna bambusoides*) in tropical areas are monopodial. Contrary to this, the other group, the sympodial type are clump forming bamboo. For example our Kako bamboo *Dendrocalamus hamiltonii*, Jathi (*Bambusa tulda*), Boluka (*Bambusa balcooa*) Bijuli (*Bambusa pallida*) etc. In general the clump forming types are seen more in lower regions while the monopodials are comparatively more seen in higher elevations. In the Peoples Republic of China our training was in the Zhejiang Province covering counties like Lin'an, Anji, Dequing, Fenghua and Xinchang. All these counties are known for rich bamboo resources and bamboo based industries. However the main type is monopodial and belong to the genus *Phyllostachys*. In China there are 80 species and variants under this genus. The most important species is *Phyllostachys pubescens*, locally known as Moso which form about 75% of bamboo production in this region. This bamboo is used in many ways. This is followed by *Phyllostachys praecox* a slightly slender bamboo mainly grown for edible shoots. *Phyllostachys prominens*, *Phyllostachys nigra*, *Phyllostachys iridescens*, *Phyllostachys sulphureus* are other species seen mostly under cultivation. Chinese cultivation techniques and management are very intensive and highly productive.

Bamboo plantations:

Bamboo plantations can be seen not only in hills and slopes but also along agricultural fields, roadsides, river and canal banks, homesteads, and in all possible areas. In China the Government provides each individual with .045 Ha. of land for cultivation in plain areas and 0.08 Ha. in hill slopes. Here one can cultivate any type of crops. As a result one can see small plots of rice, soya bean, vegetable or bamboo being grown side by side. In hills the cultivation of bamboos is extensive. In fact in county like Anji Tianhuangping there are places known as 'sea of bamboo'. Mostly bamboos are cultivated for bamboo shoots or bamboo timber! As earlier mentioned, the main species is Moso (*P. pubescence*) or *P. praecox*. Normally, in plain areas in the initial two to three years of plantation, some agricultural crops like Soya bean are planted as inter crop in bamboo plots forming a perfect model of agroforestry. Even we could see tuberose planted as undercrop in one of the intensively managed plots. The plantations are maintained with a culm density of about 2200- 3000 culms per ha. To start with a spacing of 5mX5m is given. These plots are intensively managed (Lou Yiping 2000). Apart from soil working special bamboo fertilizers and manure are applied in high dosages for enhanced production. Often tonnes of fertilzers are applied to a ha plantation. Some of the plots are irrigated through sprinkler method. For round the year shoot production to get winter shoots, spring shoots and summer shoots the soil is seen treated with Rice husk. Bamboos in most of the plantations are seen detopped at about 12 m height. This is a precaution for preventing damage due to snowfall during winter.

Each plantation is scientifically thinned to maintain the crop density and mature culms are harvested at periodical intervals.

New bamboo shoot production is not uniform every year. A good production year is followed by an off year subsequently when shoot production is less. In good years, there is large production which is in excess of what is required for the crop density. So about 2/3rd of shoots are extracted for edible shoot production. The remaining are left for bamboo timber production. The off season ones are also generally meant for timber purpose. The Chinese do not keep any of the culm in the plantation that is over 6 years. They number each culm every year and have record of all culms. 4th year or 6th year culms are extracted for timber. This is a remarkable way to have a uniform bamboo plantation. This practice can be adopted for raising plantations of monopodial bamboos of NE India.

Utilization

During the field studies we have been thoroughly exposed to the advances and progress made by China in sustainable utilisation and management of bamboo resources.

As stated earlier *Phyllostachys praecox* is mainly planted for shoot production while *Phyllostachys pubescens* (Moso) is planted for all purposes, Moso in addition to bamboo shoots, also yield bamboo timber for which it is better known. It is a multi utility bamboo used in industries for making mat board, panel board, floor board, bamboo ply, chop sticks, tooth picks, plates, fans, bamboo handicrafts, bamboo charcoal, etc. We have seen at least 18 such factories. Factories producing chopstick, tooth pick, fans, handicrafts, etc. are exquisite and earn lot of foreign exchange for the country. What is more impressive is the manufacture of bamboo ply, panel board, floorboard, scaffold, furniture, etc. The industries making these products consume large quantities of bamboo raw materials providing an assured market to the farmers for their bamboo produce. Since much of the products are exported to developed countries, the farmers get good price for their products. Further, many of these factories are in rural areas. The factories are of different size from small - scale units to very large factories. The large factories consume much of the products (semi processed products) of smaller units.

Most of the plywood, panel board or floor board factories, which we visited are similar in nature to wood based plywood factories in NE India. Hence, it should not be difficult to get the wood based ply factories transformed to bamboo based ply and panel board factories. Of course, it would be necessary to install suitable machinery.

There are number of edible bamboo shoot processing factories in this province. The produce from these factories is exported to Japan, Europe and other western countries. There is also good domestic market. However, all the factories we saw are involved mostly in exporting their produce. The processed shoots are not sold in canned tins but in vacuum sealed polybags ensuring edible quality.

It is very much evident in these manufacturing units that, great stress has been given to quality control. Most of the machineries for these units are produced in China only which are cheaper and of better quality. However in some cases, for finishing, German make machineries are used. The machinery used for monopodial bamboo is slightly different from those for sympodial bamboo.

Bamboo charcoal factories too are of different types. In some cases they are conventional ones while in sophisticated ones the bamboo is powdered, pressed and made into blocks before converting to charcoal. Bamboo charcoal is used in refrigerators to absorb odour and in electronics. Japan is the major importer of bamboo charcoal.

Bamboo in economy:

China's economic out put from bamboo sector is estimated to be over 2.1 billion US $ per year. The counties, which we visited have all registered rapid increase in economy through utilisation of bamboo. The GDP is much higher. Further after opening of Chinese economy, bamboo products fetched better market. As a result many of the rural areas could be uplifted (Lei Jiafu 2000). Today it is easily evident in rural areas that farmers are well off. They all have better housing, modern amenities and enjoy comfort and luxury. Bamboos could definitely make a change. In north east India also we have rich tradition of bamboo utilization. With proper planning and support for developing projects from INBAR (International Network of Bamboo and Rattan Research), of which India is one of the 21 member countries, we can hope for a better economy in future which is bamboo based. Bamboos are definitely quick rotation species and eco friendly. The current levels of productivity can be enhanced manifold as in China through R&D efforts. However, we need to inculcate a strong will for development, ensure quality, develop committed work culture and open mind for adopting modern technologies and using them.

By seeing all these in China, I am more than convinced that in north east India bamboos hold the key to economic progress in future. Let us be prepared for it.

This enhanced utilisation of bamboos, if takes place, may warrant for high productivity of bamboo plantations, quality propagation materials, adequate nursery stock and continued R & D support. Programmes for people's participation are to be evolved. There will also be a need for human skill development and training within the region and outside. Experts from abroad may have to be invited to impart training to our people. Networking and exchange of information will be basic to co-ordinate a smooth transition for bamboo based economy.

The State Forest Research Institute, G.B. Pant Institute of Himalayan Environment and Development, NERIST, RRL and other institutes located in this region can significantly contribute towards development of bamboo resources and industries. The SFRI has already introduced the Moso (*Phyllostachys pubescens*) bamboo to Arunachal Pradesh and standardised the method of multiplication. The performance of the bamboo in the trial location is very promising with rapid production of shoots (Bisht *et al.* 1999). Further experiments in maintenance and management of plantation are in progress.

CONCLUSION

As a concluding remark it may be mentioned that Arunachal Pradesh and other north eastern states are very rich in bamboo resources. Though they are used traditionally for a variety of purposes by the indigenous people their industrial application is so far restricted to paper industry alone. As a result much of these resources are under utilized. This scenario need to be changed with the help of international agencies like INBAR appropriate projects can be evolved to harness their renewable resources for the sake of economic development of NE regions in an eco-friendly way.

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NOTES ON THE BAMBUSETUM AT CHESSA, ARUNACHAL PRADESH

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ABSTRACT

The bambusetum at Chessa is one of the largest of its kind in North East India in terms of species composition. The paper provides an account of the bambusetum, the species and their description, phenology, distribution, culm production, etc. Only 30 species are mentioned in this article. The paper also highlights some of the constraints and problems associated with maintaining the bambusetum. It points out the need for further study.

INTRODUCTION

Bamboos are important tropical resources, favourably changing the economy of many countries the world over. They are particularly known in the developing countries spread over Asia, Latin America and Africa (Lei Jiafu, 2000). An estimated 1200 species of bamboos are present in the world while India accounts for about 13 genera and 120 species (Seethalakshmi & Muktesh Kumar, 1998). In the North East Region at present, over 89 species are seen growing. There is still a possibility of finding out some more species if detailed studies are carried out (Haridasan, Sunny Thomas and Anupam Sarmah, 2000). Due to their utility (Haridasan & Deori, 1987) bamboos have been exploited to great extend. North East India is one such region where bamboo utilization is traditionally associated with human life specially the tribal people. Though the traditional use does not endanger bamboo populations, some of the rapid exploitation like that of paper industries coupled with deforestation and habitat destruction have pushed some of the species to endangered status. The region also has reported some new species and endemic ones which are treated as endangered. Conservation efforts are essential for survival of such species. Further, information on some of our bamboos are totally inadequate or even wanting. As a means to achieve conservation and as a tool for studies on performance and agro-ecology the State Forest Research Institute has established a bambusetum at the Field Research Station Chessa (Formerly Van Vigyan Kendra, Chessa) during 1981-82 (Beniwal & Haridasan, 1988). This article narrates details of development of the bambusetum and information on different species grown in it.

Bambusetum :

Bambusetum is a specialized botanic garden where only bamboos are grown. The SFRI has one of the largest living collection of bamboos in NE India at Chessa. The Chessa bambusetum has an area of 1.5 ha at an altitude of 162 m MSL. The land is totally plain in foot hills falling under

Tropical Semi-evergreen forest type. Climatically this location receives heavy rainfall generally varying from 2500-3000 mm annually. It is quite warm during summer and moderately cold during winter. Maximum temperature recorded is about 42°C in peak summer and minimum is 4°C in peak winter. The average ranges between 30°C in summer and 9°C in winter. Relative humidity is also very high. Due to these factors only tropical and subtropical bamboos could be grown here. Because of the prevailing high altitudes Arunachal Pradesh is home to many temperate and high altitude species that do not thrive in this location. The SFRI has recently taken up efforts to establish a high altitude bambusetum at Bomdila at an altitude of 8500'. This is the first of its kind in India.

Bambusetum at Chessa has at present about 200 clumps. These clumps belong to over 30 species and some varieties(in this paper recent introductions and small clumps are excluded). Each species is planted in individual blocks. The spacing provided between clumps is 4x4 m. (Beniwal & Haridasan, 1988). Rhizomes were used for planting. These are from different parts of Arunachal Pradesh, Assam and other north eastern states. There are a few species that are collected from Kerala with the help of KFRI. Some species were got through FRI Dehradun while *Bambusa wamin* was obtained through RPRC, Bhubaneswar. This bambusetum is now acting as a germplasm conservatory, a source of propagation material and a field facility for biological research. Most of the species in the bambusetum are botanically identified and provided with latest nomenclature. However a few of them are still to be identified conclusively due to want of reproductive parts. For facilitating identification, botanical description and other relevant details for each species are provided in the following enumeration. A table showing details of clumps and their growth and culm production is also provided (**Annexure 1**).

Methodology :

The bambusetum has been established using standard plantation technique. The details adopted are given in Beniwal & Haridasan, 1987. Taxonomic identifications were made with the help of works on bamboos (Gamble, 1978, Munro, 1983, Tiwari, 1992, Seethalakshmi & Muktesh Kumar, 1998). Identification of species were also facilitated by experts from FRI Dehradun. Phenological and growth data are recorded from bambusetum through monthly and annual observations by trained staff. Each years culms are marked with painted rings to distinguish them separately to record growth and phenological behaviour. Propagation is done using rhizomes initially. To understand the possibility of multiplying them using culm cuttings an experiment was conducted wherein culms were cut into two noded pieces and kept under 5 cm of soil in standard nursery beds regularly irrigated. As treatment the nodes from base, middle and tip portion of the culms were sown separately and data recorded in case of seven species. The findings of this experiment is cited at appropriate places in this paper.

Enumeration :

In the enumeration each species is provided with correct botanical name, available local name, source of planting material, brief description, propagation, flowering, flowering cycle (wherever known), distribution, uses, etc. The species are arranged alphabetically.

1. **Bambusa balcooa** Roxb.

Local Name : As.-Bhaluka bah, Borua bah : Beng.-Balkua bans : Tripura-Barak
Meghalaya-Wamnah, Beru.

Source : Rampur village of Assam.

Taxonomic description : A tall, densely caespitose bamboo. Culms dark green, basal nodes rooted, white ring above and hairy below the node. Lower culm sheaths are short, broad, ciliated, triangular; upper culm sheaths are broad at base, triangular, almost glabrous, truncate, closely hairy below; auricle absent or very small, ciliated. Leaves 15-25 x 2-5 cm, oblong lanceolate, dark green above, pale and puberulous beneath, margin rough, petiole short.

Propagation : Through Seeds, Rhizomes and Culm Cutting. An experiment using culm cuttings for propagation was made and yielded good response. The best result for sprouting and survival was found in the cuttings of bottom part planted during July (90-100%) June (70-90%), August (50-70%) and rest (0-6%).

New Shoots: June - July

Flowering : Not flowered yet at Chessa. Flowering cycle - 35-45 years.

Distribution: a) Arunachal Pradesh: Plains and low hills upto 500 mtrs. elevation.

b) Other regions : Assam, Nagaland, Meghalaya, Tripura, West Bengal, some places of Bihar and Uttar Pradesh.

Uses : Construction of houses, i.e. as posts/pole, to make bullock cart, juwali, moi (leveler) and household works, paper industries. Shoots are edible and widely used as vegetable.

2. **Bambusa bambos** Voss
= *Bambusa arundinacea* (Retz.) Willd.

Local name : As. -Kotohabah, Katabah : Beng.- Ketuasi : Manipuri-Saneb.

Source : Forest Research Institute, Dehradun.

Taxonomic description : A tall, very densely tufted bamboo with spiny branches. Culms bright green, shinning, culm sheath 20-35 x 18-30 cm coriaceous, orange yellow when young, top rounded, margin plaited, ligule continuous with sheath top, margin ciliated, auricle inconspicuous with dark brown to blackish hairs. Leaves 7-18cm x 1-2 cm, green glabrous above, hairy beneath and at the base, linear lanceolate, shortly petioled. Inflorescence large panicle, branches spicate with a few cluster of lanceolate acute spikelets .

Note: Readily distinguished due to its thorny lateral branches.

Propagation : Through Seeds and Rhizomes.

Flowering : It is not flowered yet at Chessa. This species flowers at a cycle of 30-49 years.

Distribution: a) Arunachal Pradesh : Cultivated at Chessa.

b) Other regions : Assam, Manipur, Orissa, Tamilnadu, Kerala, Andhra Pradesh, and most of the parts of North India.

Uses : Used for construction of houses, posts/poles, bullock cart materials, paper and pulp industries.

3. **Bambusa longispiculata** Gamble ex Brandis

Local name : Mitenga.

Source : Likabali, Arunachal Pradesh.

Taxonomic description : A medium sized bamboo. Culms green, nodes thick with a circular band of white pubescence above, culm sheaths deciduous covered with blackish hairs, auricles unequal, falcate with bristle, ligule 3-5 mm, densely ciliated. Leaves 15-25 x 2-5 cm, linear oblong, glabrous above, whitish below.

Propagation : Through Seeds, Rhizomes and offsets.

New Shoots: May - June.

Flowering : In wild observed during 1997. Not flowered at Chessa yet.

Distribution : a) Arunachal Pradesh: Likabali area of West Siang District.

b) Other regions : Assam, Mizoram, Bangladesh, Myanmar.

Uses : House building, roofing, making walls, and for paper industries. Branches as fencing.

4. **Bambusa multiplex** (Lour.) Raeusch ex. Schult.

= *Bambusa glaucescens* (Willd.) Sieb.ex Munro.

Local name : Fencing bamboo.

Source : Kalimpong, West Bengal.

Taxonomic description : A small, densely tufted bamboo. Culms green, nodes thickened, internodes 15-30 cm. Culm sheaths 10 - 15 by 5 -8 cm, glabrous, ciliated, ligule narrow, entire. Leaves 4-10 x 0.3-1 cm, distichous, tip subulate, twisted.

Propagation : Through Rhizomes.

New Shoots: March - September.

Flowering : Not observed so far at Chessa. Sporadic flowering reported elsewhere.

Distribution : a) Arunachal Pradesh : Cultivated in Chessa and lower parts as hedge.

b) Other regions: Planted as fencing in Assam, West Bengal, Sri Lanka, China.

Uses : As fencing, stick, ornamental plant.

5. **Bambusa nutans** wall. ex Munro.

Local name : As. - Mokal bah, Jatia bah, Deo bah Beng- Makla, Hindi- Malabans, Khari-Seringjas, Tripura-Kali.

Source : Madhupur, Assam.

Taxonomic description : A tall caespitose bamboo. Culms green, usually less branched below, much branched above, internode 35-45 cm, nodes often hairy, rootlets in the lower ones. Culm sheaths 10-20 cm long, 20-30 cm wide at base with appressed, scattered black hairs on the back, the base bearing a ring of soft deciduous hairs, margin recurved, deccurent into large waved auricles which bear long curved bristles, ligule short, dentate. Leaves linear lanceolate pale green above, glaucous beneath, petiole short. Inflorescence a leafless panicle, bearing spicate branches with cluster of few fertile glabrous, acute spikelets. Caryopsis oblong, obtuse.

Propagation : Through Rhizomes and Culm Cutting. The experiment on propagation through culm cuttings using this bamboo was very promising. The best result for sprouting and survival were found for the cuttings of bottom part planted during the month of July (90-100%) followed by April (70-90%) September (50-70%) and rest (0-5%).

New Shoots: June - July .

Flowering cycle : There was a gregarious flowering of this bamboo during 1989 and died completely. Later these were replanted. The species flowers at a cycle of 35 years.

Distribution : a) Arunachal Pradesh - cultivated in lower altitude

b) Other regions - North West India, North East India, Sub Himalayan areas, West Bengal, Orissa, Bangladesh, Thailand.

Uses : Construction of houses, poles/posts and paper industries and branches as fencing.

6. **Bambusa pallida** Munro.

Local name : As. -Bijuli : Khasi-Seskian, Usken : Naga-Telero, Watoi : Tripura- Makal.

Source : Madhupur, Assam.

Taxonomic description : A caespitose bamboo with thick clumps. Culms olive green, smooth gradually thin above. Culm sheaths 15-30 cm long, 20-25 cm broad, slightly attenuate upwards and truncate at top, covered with appressed white hairs when young. Auricle small, round, ligule very small. Leaves 10-20 x 1-2 cm, green, linear-lanceolate, rounded at base into short petiole. Inflorescence large branching panicles with few fertile spikelets.

Propagation : Through Rhizomes and Culm Cutting. This species was also tried for propagation using culm cuttings which responded well. The best performance for sprouting and survival is found in the cuttings of bottom part planted during the month of August (90-100%) followed by those in May and September (70-90%), December (50-70%) and rest (0-5%).

New Shoots : July.

Flowering : Not observed so far. However in wild it flowered during 1997.

Distribution : (a) Arunachal Pradesh: Upto 1500 mtr. Altitude.

(b) Other regions: Assam, Meghalaya, Manipur, Nagaland, Mizoram, Tripura, Sikkim and West Bengal.

Uses : Commonly used for construction of houses, making walls, as posts, poles, roofing, fencing and paper industries.

7. **Bambusa polymorpha** Munro.

Local name : As. -Betuabah (Betwabah) : Beng.-Jama : Tripura - Bari.

Source : Forest Research Institute, Dehradun.
Taxonomic description : A tall, densely tufted bamboo. Culm greyish green covered with white scurf when young. Culm sheaths thick, covered with densely appressed brown to dark brown hairs, rounded at base and widening to two falcate auricles. ligule narrow, entire. Leaves thin, 8-18 x 1-2 cm, linear-lanceolate, short petioled, lower surface hairy.

Propagation : Through rhizomes and seeds.

New Shoots: June - July.

Flowering : Not observed so far at Chessa. The species flowers at a cycle of 55-60 years.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions: Assam, Manipur, Tripura, Meghalaya, Madhya Pradesh, Bangladesh, Myanmar.

Uses : House building, walls, paper and pulp industries. Shoots edible.

8. **Bambusa pseudopallida,** Majumdar.
Local Name : As. Small Bijuli

Source : Forest Research Institute, Dehradun.

Taxonomy : A thick, evergreen bamboo. Culms dark green or greyish green, less branching from base, much branched near the top. Culm sheath 10-25 cm x 6-15 cm, covered with blackish hair, auricle ciliated, ligule narrow. Leaves 10-15 x 1.5-3 cm with short petiole.

Propagation : Through seeds and rhizomes.

New Shoots: June- August.

Flowering : Not observed at Chessa yet.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions: cultivated in Assam (Tea Gardens), Bihar, Sri Lanka, China and Bangladesh.

Uses : As hedge plant, roofing and making wall etc

9. **Bambusa tulda** Roxb.

Local name : As. - Jati : Beng.-Tulda : Tripura-Mirtinga : Garo-Wati.

Source : Madhupur, Assam.

Taxonomic description : A tall, tufted, gregarious bamboo. Culms green and powdery when young, greyish green in maturity, lower nodes with fibrous root, internodes 30-70 cm. wall thick at the bottom. thin gradually above, branches many from nodes of top portion. Culm sheaths 14- 25 x 12-35 cm, deciduous, powdery and hairy, attenuate upwards and truncate at top, auricle long-fringed, ligule narrow, entire.

Propagation : Through seeds, rhizomes and culm cutting. An experiment on culm cutting was undertaken as mentioned earlier. The best result for sprouting and survival is found in the bottom part planted in April (90-100%), July (70-90%), August (50-70%), and rest is (0-5%).

New Shoots: May - July

Flowering : Not observed so far. Flowering cycle - 30-60 years.

Distribution : a) Arunachal Pradesh : Lower parts of the state.
b) Other regions : Assam, Bihar, Karnataka, Meghalaya, Mizoram, Nagaland, Tripura, Uttar Pradesh, West Bengal.

Uses : This bamboo is much used for building houses, agricultural and weaving materials, scaffolding, used as pole/posts, making different types of basket/mats, ornaments, musical instruments, fishing materials, furniture, and for paper industries.

10. **Bambusa wamin** Camus.

Local name : As.-Bottle bah.

Source : RPRC, Bhubaneswar. Orissa.

Taxonomic description : A medium sized graceful bamboo. Culms usually 1-6 m.(1-4 m. at Chessa), dark green, club shaped internodes (pitcher shaped) in lower half. Culm sheaths brown, hairy, 10-15 X 10-20 cm.

Note : Easily distinguished by the club shaped internodes.

Propagation : Through rhizomes and offshoots/ rooted branches .

New shoots: June.

Flowering : Not observed so far.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions: Cultivated in gardens in other states, China, Sikkim.

Uses : As ornamental bamboo, culm is used for handicrafts.

11. **Bambusa spp.** *(B. pallida var.)*

Local name : As. Nangal.

Source : Madhupur, Assam.

Taxonomic description : A caespitose bamboo with thick clumps. Culms green, smooth, striated, base curved like a plough (Nangal), internodes 45- 70 cm long. Culm sheaths 15-30 cm long, 20-25 cm broad, slightly attenuate upwards and truncate at top. Leaves 10-20 x 1-2 cm, linear lanceolate rounded at base into short petiole.

Note: The main characteristic of this bamboo is, the base, just above the rhizome, there is a curve like a plough.

Propagation : Through rhizomes and culm cutting. An experiment on culm cutting propagation was carried out as mentioned earlier and best result found for sprouting and survival for the bottom part planted during July (90-100%), August (70-90%), September (50-70%) and the rest is (0-5%).
New Shoots: June-July.

Flowering: Not flowered at Chessa yet.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions: Assam.

Uses : Construction of houses, walls, roofing, fencing and paper industries.

12. Bambusa spp. (*B. pallida.var*).

Local name : As.-Nalbah, Bijuli.

Source : Madhupur, Assam.

Taxonomic description : A profusely proliferating medium sized evergreen bamboo. Culms dark green, internodes 30-45 cm. Culm sheath 10-25 x 15-25 cm. Covered with blackish hair.

Propagation : Through Rhizomes and culm cutting. The species responded well to an experiment using culm cutting as mentioned earlier and best result found for sprouting and survival is the bottom part planted during August (90-100%), July (70-90%), September (50-70%) and the rest is (0-5%).

New shoots: June-July.

Flowering : The bamboos which were planted during May, 1981 flowered during the year 1994-1995 and clumps died completely.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions: Assam and adjoining areas of Meghalaya.

Uses : It is used for house building, roofing, making walls, fencing and for paper industries.

13. **Bambusa sp.** (*B.. pallida var.*)

Local name : Adi/Nyishi-Bijli (Jungle bijli) : As.-Pahari bijuli.

Source : Chessa/Drupong, Arunachal Pradesh.

Taxonomic description : It is like *B. pallida* (Bijuliban) but leaves and culms are thin.

Propagation : Through rhizomes.

New Shoots : July.

Flowering : Not flowered so far at Chessa.

Distribution : a) Arunachal Pradesh : All over Arunachal Pradesh upto 1500 mtr.
b) Other regions: All states of N.E. Region.

Uses : Widely used for construction of houses, roofs, walls, fencing and household materials and paper and pulp industries.

14. **Dendrocalamus giganteus** Munro.

Local name : As.-Borkako, Sourabah : Khampti - Maipo.

Source : Namsai, Lohit district.

Taxonomic description : A very tall, densely caespitose bamboo. Culms over 30-40 m tall, 40-60 cm in girth, branching above; nodes hairy, internodes 35-45 cm long covered with white waxy layer when young. Culm sheaths 45-65 cm long and broad, hard, covered with dark-brown hairs on the back, ligule 8-13 cm long, stiff, dark, auricle prominent, blade 12-30 cm. long and upto 9 cm broad. Leaves variable, 20-50 cm long, 3-10 cm broad, lanceolate, smooth above, hairy beneath, oblong, acuminate, petiole 3-5 mm long. Flowers in globose clusters arranged in large panicles. Caryopsis ovoid acute.

Note : Readily recognised due to its large culms.

Propagation : Through seeds and rhizomes.

New Shoots: July.

Flowering : Not flowered yet at Chessa. Flowering cycle - 40 years.

Distribution : a) Arunachal Pradesh : Lohit and some lower parts of East Siang district.
b) Other regions : Assam, Manipur, Nagaland, Sikkim, West Bengal.

Uses : Construction of houses, walls, posts, Mast of boats, flower vases, baskets, mats, water vessels, etc. Shoot are edible.

15. **Dendrocalamus hamiltonii** Nees and Arn. Ex Munro.

Local name : As. - Kako : Nepal - Tamo : Tripura-Peche : Nyishi – Eo.

Source : Chessa, Arunachal Pradesh.

Taxonomic description : A tall caespitose bamboo, top often curved downwards or drooping, 12-20 m high and 22-32 cm. in girth, naked below, greyish white when young with dense appraised pubescence, dull green when old, lower nodes marked with root scars, internodes 40-65 cm long. Culm sheaths long and stiff, glabrous, outer surface covered with black hairs at the base, ligule smooth. Leaves variable, 20-38 x 2-4 cm, rounded the base into a short thick petiole, broadly lanceolate, smooth above, rough beneath, finely serrate on the margins. Inflorescence a much branched large panicle with many whorls of branches bearing half verticiliate semi- globular heads of purple flower, supported by round scarious bracts. Spikelet purple, ovoid, depressed, 10 mm long. Caryopsis broadly ovoid, beaked, **Propagation** : Through seeds, culm cutting and rhizomes. An experiment on vegetative propagation was undertaken following the process as mentioned earlier. The best results show in the bottom part of which were planted during the month of April (90-100%), July (70-90%), September (50 70%) and the rest is (0-5%).

New Shoots: July - September

Flowering : Flowering observed during 1994-95 and al. clumps died. Seeds collected after flowering show 80-90% germination. Flowering cycle - 30-40 years.

Distribution : a) Arunachal Pradesh : All over Arunachal upto 1000 m.
b) Other regions: Assam, Manipur, Meghalaya, Mizoram, Sikkim, Tripura, and North West Himalaya.

Uses : Though not very durable It is widely used for temporary construction of houses, walls, for making basket, mats, vessels, fuel. Shoots are edible and have been used extensively by indigenous people.

16. Dendrocalamus hookeri Munro

Local name : As.- Seiat, Sejsai, Sijong, Utkong : Khasi - Denga : Manipuri - Ooei : Nep. - Tilibans.

Source : Along, Arunachal Pradesh.

Taxonomic description : A large tufted bamboo. Culm 15-20 m high, 10-15 cm dia., dark green, usually naked below, internodes 40-50 cm long, rough. hairy. Culm sheaths 30-40 cm broad, 20-30 cm long, densely covered with black or brown hairs outsides, glabrous inside; ligule 5-8 mm long, glabrous, serrate; auricle small, rounded, with long stiff ciliae, hairy above. Leaves large, oblong-lanceolate, with a long acuminate tip, smooth above, rough below, hairs scattered near the base, base oblique and rounded, short stalked.

Propagation : Through culm cutting and rhizomes.

New Shoots: July - August.

Flowering : Not observed so far at Chessa.

Distribution : a) Arunachal Pradesh : West Siang district.
b) Other Regions : Assam, Manipur, Meghalaya, Mizoram, North Bengal, Sikkim.

Uses : For construction of houses, basket making, water carrying etc.

17. Dendrocalamus sikkimensis Gamble.

Source : Gangtok, Sikkim.

Taxonomic description : A large caespitose bamboo with few culms; culms dark green, naked below, branching above, nodes ringed, internodes 30-45 cm long, walls thick, culm sheaths 30 cm x 40 cm densely covered with a dark golden brown belt of matted stiff hairs ; auricle falcate, fringed with long curved, fibrous, pale bristles ; ligule glabrous, sharply serrate. Leaves variable in sizes, oblong-lanceolate, acuminate with a twisted black tip ; rounded at the base into a short. thick petiole. Inflorescence a large, panicle with stiff nodes and branches, bearing large red-brown globose heads, rachis dull brown, faintly pubescent ; spikelet lanceolate, fertile flowers 2 to 3. Caryopsis obovate-depressed, apiculate, shinning above with a few hairs, wrinkled below.

Propagation : Through seeds and rhizomes.

New Shoots: July-September.

Flowering : Not observed so far at Chessa.

Distribution : a) Arunachal Pradesh : West Siang district, Lohit district
b) Other regions : Sikkim, West Bengal.

Uses : Construction of houses, pole, used in paper mill, basket making.

18. **Dinochloa compactiflora** (Kurz) Mclure.

Source : Forest Research Institute, Dehradun.

Taxonomic description : A lofty, evergreen bamboo, often scandent. Culms 4-9m high, 4-9 cm in girth, geniculate, covered by the persistent loose sheaths, greyish green. wall thin, nodes swollen, internodes 15-20 cm long, often angled when young, scabrous with brown appressed pungent hairs. Culm sheaths cylindrical, leathery, persistent, 15-20 cm long, and 17-22 mm Broad at the base, covered with densely appressed golden brown pubescence, ligule short, entire or faintly serrate. Leaves very large 6-15 cm broad, 20-45 cm long, broadly oblong, lanceolate, acuminate, base rounded into a short thick petiole.

Note: Easily identified due to the scandent nature and geniculate nodes.

Propagation : Through seeds and rhizomes.

New Shoots: April - May.

Flowering : Not flowered yet at Chessa.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions: Assam and West Bengal.

Uses : It is used for making basket, fencing, mats, etc.

19. Gigantochloa albociliata (Munro) Kurz.
= *Oxytenanthera albociliata.*

Source : Forest Research Institute. Dehradun.

Taxonomic description : A densely tufted evergreen or semi deciduous bamboo. Culms greyish green with white stripes, hirsute above. nodes raised in a ring formed by the base of the sheath. Culm sheaths 10-20 x 12-15 cm. covered with tawny oppressed hairs in the early state, afterwards smooth, somewhat truncated, folded and coriaceous at the base, terminating at the truncated mouth in a narrow naked band, ligule 1.5-2.5 cm long, truncate, toothed, auricle small. Leaves 15-20 x 2-2.5 cm. linear lanceolate, base rounded, petiole short.

Propagation : Through seeds and rhizomes.

New shoots: June-July

Flowering : Not flowered yet at Chessa. Flowering cycle - 30 years.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions : Burma, China, West Bengal, Meghalaya.

Uses : Construction purposes, making walls, fencing, etc.

20. **Gigantochloa macrostachya**. Kurz.

Local name : As. - Boruahbah : Garo - Tekserah.

Source : Cachar district of Assam.

Taxonomic description : A large evergreen bamboo. Culms 30-50 ft long, dark green when old, glaucous when young, nodes scarcely thickened, hairy. Culm-sheaths 12-20 cm long, 20-35 cm broad, densely covered with appressed blackish hairs, auricles rounded, long-fringed, wavy; ligule narrow, entire or faintly toothed. Leaves thin, lanceolate, 15-35 cm long, 1-5 cm broad, attenuated or rounded at base, petiole 1-2 cm long, glabrous above, whitish and minutely and softly puberulous beneath. Inflorescence a huge leafy panicle bearing spicate branchlets with heads of spikelet, both very long fertile and short sterile ones.

Propagation : Through seeds and rhizomes.

New shoots: July.

Flowering : Not flowered yet at Chessa.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions : Assam, Meghalaya, Bangladesh, Myanmar.

Uses : It is used for constructional purpose, making mats and baskets and also in paper and pulp industries.

21. **Melocanna baccifera** (Roxb.) Kurz.

Local name : As.-Tarai : Meghalaya-Muli : Nagaland-Turiah/Muli.

Source : Nongpoh, Meghalaya.

Taxonomic description : An evergreen bamboo with diffused clump. Culms green when young, straw-coloured when old, nodes slightly larger with a circular band of white bloom little below ; culm sheaths 10-15 cm long, yellowish-green when young, yellowish brown when old, brittle, striate, truncate or concarve at top, glabrous or sparsely with whitish oppressed hairs on the back ; ligule very short with toothed margin, auricle small, subequal, membrareous ; fringed with silvery bristles subulate. Leaves 15-30 x 2.5-5 cm, oblong-lanceolate, apex acuminate, base oblique, margins finely ciliated. Fruits large ovoid, beaked.

Propagation : Through seeds and rhizomes.

New Shoots: July and August.

Flowering : Not flowered yet at Chessa. Flowering cycle - 30-45 years.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions : Assam, Manipur, Meghalaya, Tripura, West Bengal, Mizoram.

Uses : For construction of houses, making woven wares and for paper industries. 'Tabasheer' an ancient elixir of Manipur is isolated from the culms and branches of this bamboo. (Seethalakshmi. and Muktesh Kumar, 1998). Fruits edible.

22. **Ochlandra scriptoria** (Dennst.) Fisch.

Local name : Malayalam-Ammei, Bheesa, Kolanji, Ottal.

Source : Kerala Forest Research Institute, Peechi, Kerala.

Taxonomic description : A gregarious shrubby bamboo. Culms erect, smooth, bearing persistent sheaths which occupy 1/3 of the length of the internode, culms sheaths purplish-green, hairy when young, smooth striate when old, auricle ciliated, falcate, ligule short, ciliated. Leaves linear-lanceolate, 8-25 cm x 1 to 3 cm, recorded at the base into a very short petiole.

Propagation : Through seeds and rhizomes.

Flowering : Not flowered yet at Chessa.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions : Kerala, Tamil Nadu, Andhra Pradesh.

Uses : It is used for making mats, baskets, paper and pulp industries.

23. **Oxytenanthera abyssinica** (A. Rich.) Munro.

Source : Forest Research Institute, Dehradun, U.P.

Taxonomic description : A fine distinct looking tufted bamboo. Culms bright green, branches sometimes in dense fascicles. Culm-sheaths 15-20 x 4-10 cm, overlapping, covered with dark-brown bristly hairs; ligule short. Leaves 5-25 x 1-3 cm, linear lanceolate to lanceolate, glaucous.

Propagation : Through seeds and rhizomes.

New Shoots: July and August

Flowering : Not so far observed at Chessa.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions: Tropical Africa and cultivated in some states of India.

Uses : Construction of huts, walls, etc. Culms are used for paddles canoes and the smaller ones as shaft for spears. It gives good yield of pulp, but not comparable in quality with other pulp yielding species (Seethalakshmi and Muktesh Kumar, 1998).

24. **Phyllostachys assamica** Gamble ex. Brandis

Local name : Bijae, Ziro bamboo.

Source : Ziro, Arunachal Pradesh.

Taxonomic description : A non clump forming bamboo. Culms smooth whitish green, nodes prominent, branches fasciculate at the nodes. Culm-sheaths striate, rounded above, leaves petiolate.

Note : The high altitude single stem bamboo in Arunachal Pradesh.

Propagation : Through Rhizomes.

New shoots: April-October.

Flowering Not flowered yet at Chessa. Flowering cycle - 120 years.

Distribution : a) Arunachal Pradesh : Lower Subansiri and West Kameng district.
b) Other regions: Meghalaya, Sikkim.

Uses : It is widely used by the Apatani people for construction of houses, making walls, roofing, posts, etc.

25. **Pseudosassa japonica** (Sieb. and Zucc. ex Steud.) Makino ex Nakai.

Source : Forest Research Institute, Dehradun.

Taxonomic description : A caespitose bushy bamboo. Culms thin, ultimate branches feather like. Leaves small narrow lanceolate, pale green to yellowish green.

Propagation : Through Rhizomes.

New shoots : June.

Flowering : Not flowered yet at Chessa.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions : Cultivated as ornamental plant in India, China, Japan.

Uses : As ornamental plant for aesthetic landscaping.

26. **Schizostachyum fuchsianum** (Gamble) Majumdar
= *Cephalostachyum fuchsianum* Gamble.

Source : Tidding, Lohit district.

Taxonomy : A medium sized, semi-scandent bamboo. Culms thin walled, 5-12 m high, 12-27 cm, girth, pale, vertically branched from the nodes. Culm sheaths thin, striate, reticulately veined at the edge, ligule small. Leaves large, ovate-lanceolate, base with long petiole, glabrous on both surfaces, scabrous on the margins. Inflorescence a dense globular terminal head, spikelet small, elongated. Seeds ovoid ellipsoid, beaked.

Propagation : Through seeds and rhizomes.

New shoots: June.

Flowering : It flowered in the Lohit district of Arunachal Pradesh during the year 1995. Not flowered yet at Chessa.

Distribution : a) Arunachal Pradesh : West Kameng, West Siang, East Siang, Lohit District.
b) Other regions : Nagaland.

Uses : Construction of wall, fencing, seeds used as food.

27. **Schizostachyum pergracile** (Munro) Majumdar
= *Cephalostachyum pergracile* Munro.

Local name : As.-Pithakhowabah : Khampti - Khollam.

Source : Forest Research Institute, Dehradun.

Taxonomic description : A deciduous tufted bamboo. Culms erect, glaucous green, sometimes whitish puberulous below the nodes, 11-16 m high, 18-24 cm girth, internode 30-40 cm Long, nodes scarcely thickened. Culm sheaths 10-15 cm long, 15-20 cm broad, densely covered with chestnut brown and blackish hairs, decurrent into a wavy fringe bordering the top of the sheaths and ending on either side in a round auricle, both auricle edged with long, stiff and white bristles; ligule very narrow, entire. Leaves linear-lanceolate, 15-25 cm long by 3-4 cm wide, petiole short.

Propagation : Through seeds and rhizomes.

New Shoots: June.

Flowering : Not flowered yet at Chessa. Flowering cycle - 40 years.

Distribution : a) Arunachal Pradesh : Lohit district.
b) Other regions : Assam.

Uses : Constructional purpose, fencing, for cooking rice and rice powder to prepare cake.

28. **Schizostachyum polymorphum** (Munro) Majumdar
= *Pseudostachyum polymorphum* Munro.

Local name : As.-Bojal, Tolli : Garo hills- Wachall.

Source : Tarajuli, Arunachal Pradesh.

Taxonomic description : A semi-arborescent bamboo with culms arising singly from a long, creeping rhizomes, culms branching at the top, nodes almost smooth, internodes 15-30 cm, glaucous at first, afterwards green, whitish below the nodes, sometimes dark red shading into bright green, smooth below, walls very thin. Culm-sheaths triangular, truncate in outline, very shortly auricle with tuft of stiff bristles, covered outside with appressed dark brown hairs. Leaves oblong-lanceolate 5-35 x 2 – 5 cm, smooth, unequal at the base and narrow, thick petiole. Inflorescence panicles, seeds small, ovoid, brown, hard.

Propagation : Through seeds and Rhizomes.

New shoots: May-June.

Flowering : Not flowered yet at Chessa. Sporadic flowering noticed in Lohit and Siang districts during 1985 and 2000. Flowering cycle - 50-55 years.

Distribution : a) Arunachal Pradesh : scattered all over the state along lower plains and mid hills upto 1500 mtrs elevation.
b) Other regions : Assam, Arunachal Pradesh, Manipur, Meghalaya, Nagaland, etc.

Uses : It is used for making mats, baskets, and walls of huts. Tender shoots are used as vegetable.

29. **Thyrsostachys oliverii** Gamble

Source : Forest Research Institute, Dehradun, Uttar Pradesh.

Taxonomic description : A medium sized bamboo with straight culms from a thick rootstock. Culms green covered with brown persistent sheaths, clothed on the back with thick white stiff pubescence, somewhat rounded at the top, auricle slightly prominent, ligule serrate. Leaves light green, linear-lanceolate, acuminate, rounded at the base into a short petiole. Inflorescence a large compound curved thyrsoid panicle. Caryopsis 0.8 to 1 cm long, glabrous, cylindrical, with somewhat broader top, ending in a long beak formed by the persistent base of the style, pericarp crustaceous.
Propagation : Through seeds, culm cutting and rhizomes.

New shoots: August.

Flowering : The bamboos flowered during 1986 and died. Flowering cycle - 48-50 years.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions : Myanmar and cultivated in some states of India.

Uses : It is used for construction of houses, poles, making baskets, etc. Young shoots edible.

30. **Thyrsostachys regia** (Munro) Bennet

Source: Palghat, Kerala.
Taxonomic description : A very graceful tufted bamboo. Culms straight, thick walled, base usually covered with the persistent culm sheaths. Culms-sheaths 20-25 x 10-20 cm covered with fine white pubescence on the back, attenuate to 3.5 to 4 cm broad truncate top; ligule 2 cm. long, narrow, irregularly toothed, finely ciliated. Leaves 8-15 cm long, 0.8-1.2 cm broad, narrow, linear, glabrous, stalk short.

Propagation : Through seeds and rhizomes.

New shoots: June.

Flowering : Not observed at Chessa so far. Flowering cycle - + 40 years.

Distribution : a) Arunachal Pradesh : Cultivated at Chessa.
b) Other regions: China, Malaysia, Myanmar, Thailand and cultivated in some places in India.

Uses : As ornamental bamboo, tender shoots are edible.

CONSTRAINTS

The development and maintenance of the bambusetum had some constraints and problems to be overcome as listed below:

All species of a state like Arunachal Pradesh with widely divergent altitudes cannot be cultivated in one single place as in Chessa. The temperate ones are cultivated at Bomdila at about 8000' altitude.

It was difficult to obtain rhizomes of certain species which are very rare. Mention may be made of *Dendrocalamus sahnii*. There was a single clump at Joram from where the rhizome was not available.

Transportation of rhizomes from far flung areas are very difficult due to their heavy nature.

The duration involved in transporting to destination also is vital, as the longer the duration the poorer is the chance of survival due to desiccation, etc.

Certain species like *Schizostachyum arunachalensis, Schizostachyum helferi* though growing well in wild all efforts to transplant in the bambusetum failed. On transplanting as culm or clumps they die. This may need investigation to find out any role of Mycorrhiza etc.

After planting the young plantation is exposed to great risk of cattle browsing and damage by elephants. Even grown up plantation are destroyed by elephants.

An appropriate fencing can help solve this issue. At Chessa different fencing techniques like trench, covered trench and power fencing were tried. The power fencing proved to be very effective and economical too (Haridasan & Deori, 1988).

Further, those bamboos with edible shoots are damaged by people for their edible shoots. Species like *Dendrocalamus hamiltonii, Bambusa balcooa*, etc. are particularly exposed to such threats often threatening the survival of the clump.

The mature culms need to be extracted through scientific means. In many instances scientific prescriptions are not followed which lead to damage.

Flowering though, a natural phenomenon where flowered clumps die after flowering, there is possibility of the whole collection being removed from the bambusetum. The chances of regeneration are poor in case of lack of seed set (as happened in case of *B. nutans*) or even after seed production due to rodent attack.

Natural calamities like cyclones and hailstorms also pose problem to some extend. The effect of disease and pests are also marked in some species.

Perhaps the greatest constraints would be fund support. Maintenance of a bambusetum warrants for adequate funds, which is often not sufficient leading to poor management.

The constraints listed above are not difficult to overcome. With such issues sorted out the bambusetum is poised to provide valuable data and scientific knowledge for development of bamboo for the welfare of human kind.

CONCLUSION

The State Forest Research Institute, Arunachal Pradesh has established a bambusetum at Chessa in Papum Pare district which is one of the pioneering efforts in this part of the country. The bambusetum has over thirty species and details of each species is given in the paper. Apart from being a conservation garden this bambusetum also acts as center for experimental studies. Growth and culm production are discussed in the paper. It also looks into some of the constraints faced in developing the bambusetum so that future efforts in this direction, can plan for over_coming such problems based on these experiences. The prospects of addition of new species, extension of area and further research for better understanding of bamboo is a never ending process.

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ANNEXURE - I

Table showing details of bamboo clumps, growth, culm production, extraction, etc. in the bambusetum at Chessa.

Sl. No.	Botanical name	No. of clumps	Year of planting	Total No. of culms	Culmp diameter	Avg. hgt. of culm.	Clumps extracted	Remarks
1.	Bambusa bambos (Katabah)	2	1981	171	20.5m	15-22 m		
2.	B. balcooa (bhalukabah)	14	1981	475	10.48 m	24.5 m	186	
3.	B. multiplex (Fencing bamboo)	3	1983	850	5.22 m	3.5 m	50	
4.	B. longispiculata (Mitenga)	9	1988	485	6 m	8.15 m	17	
5.	B. pseudopallida (small bijuli)	4	1982	153 per culm	4.27 m	8 m		Flowered
6.	B. nutans (Mokal bah)	8	1987	185	11.48 m	16.5 m	163	Flowered
7.	B. pallida (Bijuli)	12	1981	90 per clump	13.78	21 m		
8.	B. polymorpha (Betuabah)	3	1982	73 per clump	8 m	20 m		
9.	B. tulda (Jati)	18	1981	300	14.33 m	23 m		
10.	B. wamin (Bottle bah)	5	1990	18 per clump		4 m		
11.	Bambusa spp. (var. pallida) (Nangal)	11	1981	491	13.03 m	20 m	383	
12.	Bambusa spp. (var. pallida) (Nalbah)	4	1983	461	7.63 m	13 m	369	
13.	Bambusa spp. (var. pallida) (Jungle bijuli)	12	1982		12 m	18 m		
14.	Schizostachyum fuchsianum	3	1986	91	4 m	12 m	90	Flowered
15.	S. pergracile (Pithakhowabah)	4	1982	77	5.63 m	16 m		

Sl. No.	Botanical name	No. of clumps	Year of planting	Total No. of culms	Culmp diameter	Avg. hgt. of culm.	Clumps extracted	Remarks
16.	Dendrocalamus giganteus (Borkako)	1	1991	7	60 cm	30 m		
17.	D. hamiltonii	13	1981	184 per clump	11.03 m	20 m		Flowered
18.	D. hookeri (Sijong)				10-15 cm	15-20 m		
19.	D. sikkimensis	3	1995	15			25	
20.	Dinochloa compactiflora	1	1982	10	5.2 m	9 m		
21.	Gigantochloa macrostachya (Baruahbah)	2	1984	50	12 m	18 m	96	
22.	Melocanna baccifera (Muli)	9	1990	125			100	
23.	Ochlandra scriptoria (Anmei)	4	1990	206	2.8 m	4.3 m	60	
24.	Oxytenanthera abyssinica	4	1982	136	6.30 m	13 m	66	
25.	Gigantochloa albociliata	4	1982	150	4.73 m	15 m	100	
26.	Phyllostachys assamica (Apatani bamboo)	2	1988	18				
27.	Pseudosassa japonica	4	1982	1583	5.7 m	4 m	2020	
28	Schizostachyum polymorphum (Bejal)	3	1986	53	7 cm	5	42	
29	Thyrsostachys oliverii	12	1982	520	3.24 m	13 m	243	Flowered
30	Thyrsostachys regia	1	1990	70	3.52 m	12 m	42	

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COMMON WILD VEGETABLES OF NYISHI TRIBE OF ARUNACHAL PRADESH

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ABSTRACT

The *Nyishi* tribes in Arunachal Pradesh utilize many wild plants as food, fodder, medicine, etc. The present paper deals with some of the common wild vegetables used by the tribe. In all 25 species are listed giving their scientific name, family, local name, uses and diagnostic description. The paper also suggests for detailed ethnobotanical studies.

Arunachal Pradesh is situated in the north east extremity of the country. It has international frontiers with Bhutan in the west, China in the north and north-east and Myanmar in the east ; while it borders the states of Nagaland and Assam in the south-east and south. It is the largest state among the states in north east India covering an area of 83,743 sq. km. Out of this 68,757 sq. km is under the Forests cover with diverse flora and fauna. This biodiversity is recognised as one of the richest in India. Thus the whole state is considered a mega biodiversity 'hotspot'. This flora and fauna is also the source of many resource that are available to the people of the state.

The state is inhabited by 25 major tribes and over 110 subtribes belonging to the Indo-Mongoloid racial stock. Among them the Nyishi are prominent tribes largely inhabiting the districts of Papum Pare, Lower Subansiri, Upper Subansiri and East Kameng of Arunachal Pradesh. They lead an intimate life with nature and in perfect harmony with it depending for their day to day needs from the forests and environment surrounding them. This co-existence and history of living together since time immemorial has contributed to accumulation of rich knowledge base in respect of utility of different plants and plant parts. Thus they are experts in finding their requirements of food, fuel, fodder, medicine, cordage and various domestic needs from the local vegetation. Among these they also use wild plants as vegetables like other tribes in north east India (Arora 1981; Jain S.K. 1981; Haridasan *et al* 1990).

The food plants and wild edible plants among this utility flora deserve much attention as many of these plants are unconventional and not known elsewhere. The traditional knowledge of Nyishi can provide additional food source which would be helpful for the lean periods and scarcity.

In the present paper an investigation was made about the wild plants that has been used as vegetables by the Nyishi tribe of Arunachal Pradesh. In the enumeration provided below wild edible plants used as vegetables have been mentioned with botanical name, Vernacular name (A. Assamese, N. Nyishi), Family, description, parts used and its importance.

1. **Amaranthus** spp.

Family: *Amarantaceae*

Local name: Puchu Panya (N)

Diagnostic description: An erect stout herb. Leaves ordinarily ovate, oblong or lanceolate, decurrent at the base into petiole, glabrous. Flowers are small in cluster congested on the axis or forming simple more or less interrupted spikes.

Habitat: Homesteads, jhum fallows, cultivation fields, abandoned fields.

Parts used: Stem and leaves.

Uses: The stem of the plant is taken after peeling off the cover of the stem into pieces. The leaves are also used as vegetables.

2. **Bauhinia variegata**

Family : *Caesalpiniacea*

Local name : Baga-Katra (A), Pacham (N)

Diagnostic description: It is a small tree with 3-5 m height. Leaves are ovate to subrotundate bifid, lobes obtuse, flowers bright mauve to rosy in terminal racemes. Pods, narrowly oblong, acuminate, globes, 6-12 seeded. Seeds orbicular whitish brown.

Distribution and habitat: It is found in dry deciduous forest.

Parts used : Leaves

Uses : Tender leaves and flowers are used as vegetable.

3. **Bidens biternata**

Family : *Asteraceae*

Local name : Takam Pechi, Tagam Nyeinyam (Nyishi)

Diagnostic description : Herbs, leaves opposite or subopposite pinnately lobed. Heads white with ligulate or tubular flowers. Fruits with three claw like thorns for facilitating dispersal.

Habitat : Forest clearings, road sides, jhum fallows, open places.

Part used : Young leaves

Uses : The young leaves are cooked and eaten as vegetables. Fresh shoots are considered as piguant and rich in vitamin C. Herb is pectoral, expectorant, and emmenagogue. Juice of fresh herb is used in eye and eardrops. Roots and seeds are used in asthma.

4. **Calamus acanthospathus**

Family : *Arecaceae*
Local name : Tasar (N)

Diagnostic description : Thorny climbing palms ; stem covered by densely thorny sheaths ; leaves large pinnate spiny ; inflorescence long and branched flower small green ; fruits scaly and brown dropes seed hard covered by pulp.

Habitat : It is found in wet marshy area with forest cover over head

Parts used : Fruits and the tip of the stem.

5. **Chenopodium album**

Family : *Chenopodiaceae*

Local name : Bathugsak (A), Teya Ao (N)

Diagnostic description : It is an erect herb usually coated with a mealy substance, stem and inflorescence sometimes tinged with purple or red. Leaves very variable, smaller upwards, oblong lanceolate or rhomboid - lanceolate more or less toothed or tabulate.

Habitat : Usually cultivated in jhum fields and homesteads. Sometimes run wild.

Parts used : Young tender shoots and leaves.

Uses : The young tender shoots and leaves are cooked and eaten as vegetable by the local people.

6. **Clerodendron colebrookianum**

Family : *Verbenaceae*

Local name : Nephaphu (A), Poto, Tapin (N)

Diagnostic description : A shrub about 15 feet high with globose crown and disagreeable smell. Bark shinning light grey, leaves broad, acute, entire, memberanous, almost glabrous, flowers are white colour and in broad terminal compact, corymbiform. Compound cymes ; bract cauduceres. Fruits are bluish green when fully ripened.

Habitat : It is commonly found in the tropical and subtropical forest. Also cultivated.

Parts used : Flowers and leaves.

Uses : The leaves and flowers are eaten as vegetables. The local people along with rice and to control high blood pressure and stomach disorder take the boiled soup with leaves.

7: **Conocephalus suaveolens**

Family : *Moraceae*

Local name : Hogen (N)

Diagnostic description: Lianas, leaves shinning green, stipules reddish viscid, flowers minute green in head like cymes arranged in punicles.

Habitat : Tropical forests climbing over other trees.

Parts used : Leaves

Uses : The leaves are cooked and eaten as vegetables. The sap is used for eye troubles and the roots for poulticing itching.

8. **Dendrocalamus hamiltonii**

Family : *Poaceae*

Local name : Kakua (A)

Diagnostic description : A large bamboo with caespitose culms, growing tall and erect, but more often sending out its stems at an angle or curved upwards. Culms long, 12-20 m or up to 25 m tall, usually naked below much branched above ; 10-18 in diameter, greenish-white when young with dense apprised pubescence, dull green when old ; nodes marked with root scars, internodes 30-50 cm long, wall 1.25 cm thick.

Part used : Young tender shoots

Habitat : Jhum fallow and forest clearings

Uses : The young shoots are cut into pieces. They are allowed to be fermented into a bamboo far (Hikku). The smaller pieces are dried in sunlight and allowed to ferment (Hüyup). It will have a sour taste.

Alternatively the young shoots are collected and wrapped in banana leaves and tied properly. It is allowed again to ferment near a stream (Hichur). When fermented it is torn by hands and boiled with meat of chicken, goat, etc. and eaten.

Sometimes the young shoots are also collected and they are roasted in fire (Heppe). This is again boiled and eaten for different taste it provides.

9. **Diplazium esculentum**

Family : *Athyriaceae*

Local name : Takka Peya (N)

Diagnostic description : It is terrestrial fern. Rhizomes wide, creeping, woody, stout, covered with very narrow, linear, dark, stiff scales ; stelar organisation sole nostela. Stripes long, erect, slender, glabrous. Fronds remote, not articulate to rhizome ; lamina large, coriaceous, fan shaped, divided to the base in two equal parts, each half dichotomously divided into more or less deeply lobed segments ; venation reticulate, the main veins more or less equally and repeatedly dichotomous, lateral perpendicular veins forming complicated network with free veinlets in the arcoles.

Habitat : Wastelands, open places

Parts used : Young tender leaves.

Uses : The young tender leaves of the plant is collected, cooked and eaten as vegetables.

10. **Erythrina stricta**

Family : *Fabaceae*

Local name : Madar (A), Tagek chaegne (N)

Diagnostic description : A fairly large tree with a striking appearance when in flower. Bark deeply furrowed, greenish yellow. Outside, with strong prickles, inside white or dark brown with white streaks, branchlets stout, glabrous, with many slightly incurred prickles, shoots pubescent when young. Flowers are coral red in colour.

Habitat : Deforested areas and wastelands. Sometimes cultivated along the fences.

Part used : Young tender leaves

Uses : Young tender leaves are boiled and eaten as vegetable. The tree is planted along the boundary of farming area as its stem are thorny it acts as bio-fencing to protect from wild and domestic animals. It is also used in the rituals (Auy).

11. **Euphorbia hirta**

Family : *Euphorbiaceae*

Local name : Tador Ao (N)

Diagnostic description : Usually an annual and biannual herb ; stem erect pubescent. Leaves are lanceolate, acuminate, puberulous, base rounded, petiole very short.

Habitat : Degraded forest land, moist shady areas.

Part used : Leaves, shoots and stem.

Uses : The leaves, shoots and stem of the plant is cooked and eaten as a vegetable. The local people identify it as tador, which means earthworm because of the appearance and colour of the stem of the plant.

12. **Fagopyrum cymosum**

Family : *Polygonaceae*

Local name : Hukku (N)

Diagnostic description : Herbs, erect, leaves ovate cordate or truncate, stipute sheathing flowers white or pinkish in terminal or axillary cymes.

Habitat : Jhum fields, jhum fallow, road sides or often run wild.

Parts used : Leaves.

Uses : The leaves are cooked and eaten as vegetables. Principally it is a fodder plant. The grains are used in cold, cholera, diarrhoea and abdominal obstruction.

13. **Hedychium spicatum**

Family : *Zingiberaceae*

Local name : Telli (N)

Diagnostic description : Erect tall herbs with ginger like rhizomes leaves oblong lanceolate acute or acuminate base narrowed to the sheathing petiole. Flowers in terminal cone line races.

Habitat: Moist and shady localities. Forest margins jhum fallow.

Parts Used : Young shoots.

Uses : The young shoots are collected and they are peeled off. The inside portion is cooked and eaten as vegetable. The aromatic rhizome is employed in the preparation of the Abir. It is also considered as stomach ace, carminative, stimulant and tonic and used in dyspepsia, yields an essential oil used as soap, hair oils, and face powder.

14. **Houttuynia cordata**

Family : *Saurouraceae*

Local name : Checha Peya (N)

Diagnostic description : A perennial herb with creeping root stock. Leaves broadly ovate acuminate, membranous, gland dotted, pubescent on the nerves specially when young. Base cordate, sheating narrowed into the petiole, stipules linear lanceolate. Flowers minute in dense flowered spike with petalloid bracts.

Habitat : Usually found in subtropical locations. Also cultivated.

Parts used : Leaves

Uses : The leaves of the plant are eaten raw. It is generally eaten as salad or chutney. The cooked leaves are also consumed by the local people as vegetable.

15. **Ipomoea batatas** (Sweet potato)

Family : *Convolvulaceae*

Local name : E-ghen Phér (N)

Diagnostic description : A prostrate annual trailing creeper on the ground, producing root tubers. Leaves ovate-cordate more or less lobed. Flowers are purple in colour.

Habitat : Usually cultivated in jhum fields sometimes run wild.

Parts used : Tubers and young tender shoots.

Uses : The young tender shoots of the plant is collected and boiled and eaten by local people as vegetable. The tubers are eaten boiled or roasted or even raw.

16. **Manihot esculenta**

Family : *Euphorbiaceae*

Local name : Tanu (N)

Diagnostic description : Shrubs ; stem greyish brown with petiole base marks, leaves palmate lobed, laticiferous, flowers greenish white.

Habitat : Cultivated in jhum fallows and kitchen gardens, fencing, etc.

Uses : The young tender leaves of the plant is often boiled with meat of pig, goat, etc and eaten. It adds the flavour and aroma into the meat. Tuber eaten boiled or roasted.

17. **Musa spp.**

Family : *Musaceae*

Local name : (Wild banana), Athia Kol (A), Moro kopa (N)

Diagnostic description : Tall herbs with pseudostem and a crown of broad large leaves. Inflorescence a long spadix fruits appear in branches.

Habitat : It is found in the humid/marshy subtropical forests.

Parts used : Young inflorescence and young of the stem.

Uses : After collecting the young inflorescence (Pupuk) they are chipped into pieces by knife. It is mixed with meat or blood of animal and filled into a green bamboo clumps. It is roasted over the fire. After being cooked, it is eaten.

18. **Mussaenda roxburghii**

Family : *Rubiaceae*

Local name : Soklat (A), Eshi-Hagmi (N)

Diagnostic description : Small shrubs upto 3 m high. Flowers in terminal subcapitate cymes, yellow or orange-yellow, petaloid, sepals oblong-lanceolate, white.

Habitat : Tropical forests

Parts used : Young leaf shoot, and flowers

Uses : The young leaves shoots and flowers are often collected, cooked (boiled) and eaten as a vegetable.

19. **Rhynchotechum ellipticum**

Family : *Gesnesiaceae*

Local name : Jooke (N)

Diagnostic description: It is an under shrub ; young parts downy tomentose. Flowers in trichotomously paniculate cymes, pinkish-white, fruits berry.

Habitat : Forest undergrowth, moist shady areas.

Parts used : leaves

Uses : The tender parts of the leaves are often collected, cooked (boiled) with meat and eaten as vegetable.

20. **Sarcochlamys pulcherrima**

Family : *Urticaceae*

Local name : Bhola chaegne (N)

Diagnostic description : Small trees, leaves linear lanceolate crenate, white beneaths, flowers greenish white in panicled clusters.

Habitat : Tropical hill slopes, secondary forests.

Parts used : The young tender leaves.

Uses : The young tender leaves of the species are often collected, cooked and eaten as vegetable by the local people.

21. **Selaginella** spp.

Family : *Selaginellaceae*

Local name : Husum (N)

Diagnostic description : It is a terrestrial herb, stem pinately branched, leaves dlimorphic, membranous, sporangia yellowish-green.

Habitat : Very moist shady localities.

Parts used : Stem and leaves.

Uses : The whole plant is cut at base often cooked (boiled) and eaten as a vegetable by the local people.

22. **Solanum nigrum**

Family : *Solanaceae*

Local name : Hor (N)

Diagnostic description : A sufrutescent annual herb. Leaves ovate lanceolate or ovate oblong, entire, sinute toothed or lobed, acute or acuminate thin, glabrous, base narrowed into the petiole, flowers are white in colour, and small ball shaped. Berries are shinning black in colour.

Habitat : Near homesteads, open places, road sides abandoned jhum fallows, etc.

Parts used : Young leaves.

Uses : Tender young leaves are boiled and eaten. The local people consider it good for stomach disorders.

23. **Spilanthus paniculata**

Family : *Asteraceae*

Local name : Nemdek Ao, Mersha Ao (N)

Diagnostic description: It is much branched herb with stem and branches more or less hairy. Leaves opposite, ovate, acute or subobtuse, irregularly crenate-serrate or sometimes entire, glabrous or nearly so, base usually acute.

Habitat : Road sides, jhum fallows, moist and wet locations, forest margins.

Parts used : Young leaves and flower heads.

Uses : The young leaves and flower heads are cooked and eaten as vegetables. The flower heads are chewed to relieve toothache. Decoction of the leaves is given as diuretic and lithotriptic.

24. **Spondias pinnata**

Family : *Anacardiaceae*

Local name : Amoora-tenga (A), Tanyan (N)

Diagnostic description : It is a tree, bark with vertical streaks. Leaves pinnate, sour in taste. Flower long spreading panicles, creamy white or yellow. Fruits edible, drupe.

Habitat : Tropical forests

Parts used : Leaves

Uses : The young leaves are collected, cooked and eaten as vegetables. Ripe fruits eaten raw.

25. **Zanthoxylum oxyphyllum**

Family : *Rutaceae*

Local name : Mezenga (A), Honyor (N)

Diagnostic description : It is slender struggling shrubs scrambling on trees, very aromatic, glabrous, prickles usually hooked. Leaves 6-14 inches long, rachis armed with prickles beneath and with 2 faint longitudinal ridges above. leaflets are strongly aromatic. Very variable in size and shape, elliptic or lanceolate, often taper pointed, subcoriaceous, entire, crenate or crenulate with translucent gland at each sinus.

Habitat : Tropical forests

Parts used : Tender shoots and leaves.

Uses : The tender shoots are eaten cooked as vegetable. As the leaves are aromatic is added with the curry of the meat in order to give flavour.

CONCLUSION

The state of Arunachal Pradesh has a diverse flora which is a store house of many useful plants. The people of the state, particularly the Nyishi tribe has profound knowledge about these useful plants. The wild edible plants are an important group in this category. Many of these plants used by the tribe are unconventional and not known to people outside. Further this knowledge which rests with rural people and older generation are slowly fading away due to the onslaught of alien cultures. It will only be appropriate to document this information before it is too late. Accordingly an attempt is made here to enlist some wild edible plants. A total of 25 plants are described here. A perusal of the list will reveal that plants of all habits like herbs, shrubs, trees and climbers are represented among them. They also represent widely divergent families from dicots to monocots. Though in most cases it's the leaves that are used. Other parts like tubers, fruits, young shoots and even, flowers are used in some other cases.

LIST OF COMMON WILD VEGETABLES OF NYISHING TRIBES

Sl. No.	Scientific name	Family	Local name Nyishi	 Assamese	Time of Collection
1.	Amaranthus spp.	*Amarantaceae*	Puchu panya	Khutura sak	Sept-Oct.
2.	Bauhinia variegata	*Leguminaceae*	Pacham Ao	Kanchan	March-April
3.	Bidens biternata		Takam peshi		June-Aug.
4.	Calamus acanthospathus	*Arecaceae*	Tasar	Bet	April-May
5.	Chenopodium album	*Chenopidiaceae*	Teya	Jilmil	Oct-Jan
6.	Clerodendrum colebrookianum	*Verbenaceae*	Poto, tapin	Nephaphu	March-April
7.	Colocasia spp.	*Araceae*	Nigrik		April-May
8.	Conocephalus suaveolens	*Moraceae*	Hogen		July-Aug.
9.	Crassocephalum crepidioides	*Asteraceae*	Yemen/Pakcho		Dec-Jan.
10.	Dendrocalamus hamiltonii	*Gramineae*	Aa	Kako	August-Sept.
11.	Diplazium esculentum	*Athyriaceae*	Taka, Paya	Dhekia	June-Aug.
12.	Erythrina stricta	*Leguminoseae*	Tagek	Madar	March-April
13.	Euphorbia hirta	*Euphorbiaceae*	Tadar/Ao		Aug-Sept.
14.	Fagopyrum cymosum	*Polygonaceae*	Hukku		May-July
15.	Hedychium spicatum	*Zingiberaceae*	Tellli	Taara/ Sobleksin	June-Aug.
16.	Houttuynia cordata	*Piperaceae*	Chechapeya/ Hangya	Machandari	April-May
17.	Ipomoea batatas	*Convalvulaceae*	E-ghen pher	Mitha-alu	March-April
18.	Manihot esculenta	*Euphorbiaceae*	Tanu		May-August
19.	Musa spp.		Moro kapak	J-kal	March-April
20.	Mussaenda roxburthii	*Rubiaceae*	Eshi-Hagmi	Phutuka	April-May
21.	Pouzolzia bennetiana	*Urticaceae*		Huick	
22.	Rhynchotechum ellipticum	*Gesneriaceae*	Jooke		April-June
23.	Sarcochlamys pulcherrima	*Urticaceae*	Bhola		June-July
24.	Selaginella spp.	*Zingiberaceae*	Husum		July-Aug.
25.	Solanum nigrum	*Solanaceae*	Hor	Salu bhekuri	Aug-Oct.
26.	Spilanthus paniculata	*Asteraceae*	Mersha, Namdak Ao	Shuhonibon	June-Aug.
27.	Zanthoxylum oxyphyllum	*Rutaceae*	Honyor	Mezenga	June-Aug.
28.	Spondias pinnata	*Anacardiaceae*	Tanyan	Amoora tenga	April-July

This paper by no means is exhaustive. It is certain that detailed and exhaustive ethnobotanical surveys can bring out much more interesting information from this floral wealth. Apart from taking up such studies, some of these plants and plant parts need to be tested for their nutritional value which might bring out wonderful results and possibly prove to be of economic utility. Studies on preservation and processing will also be rewarding.

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SOME COMMERCIALLY IMPORTANT MEDICINAL PLANTS OF NORTH EASTERN INDIA

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ABSTRACT

North eastern region of India is a store house of medicinal plants. Most of he pharmaceuticals and drugs companies get their raw materials from these medicinal plants. This paper highlights the information and cultivation of some common and important medicinal plants available in N.E. India which can be grown for the economic benefit by the local people particularly in rural areas. Twenty two species of medicinal plants are described suitable for commercial cultivation in N.E. India.

INTRODUCTION

There are 6000 flowering species in North-Eastern region of the Indian sub-continent and out of these more than 1000 plants are reported to be used as medicine in one or the other way by the local people of the region. These medicinal plants have been used traditionally either by eating them as raw drugs, in form of extracts from the plant, mixing with honey, milk, other juice, as vegetable or apply it directly to the affected parts/persons. Now a days most of the pharmaceutical companies are increasingly relying on raw material from the plants for manufacturing medicines.

The North-Eastern region having altitudinal range from 150 meters to over 5000 meters has different climatic conditions according to altitude. Different medicinal plants grow at various altitude and are used by the local people living in the region. For example, *Coptis teeta, Aconitum ferox, Panax sikkimensis, Valeriana* sp. and *Taxus baccata* grow in high altitude, while *Acorus, Rauvolfia, Piper, Andrographis,* etc. grow in lower elevation. Most of the medicinal plants grow in wild conditions and due to large scale collection of these medicinal plants, these are getting highly depleted. As there is a great demand of such medicinal plants which are used by the reputed pharmaceuticals and drugs companies, cultivation of these medicinal plants in large scale will be beneficial as it is comparatively easy to cultivate such plants in local climatic conditions. Following are some prospective and important medicinal plants appropriate for commercial cultivation in lower altitudes. The list also gives vernacular name in Assamese and Hindi, family of the medicinal plants, useful part and their traditional use. The commercial demand and value/kg of these medicinal plants, is also compiled along with names of the pharmaceutical companies, who are using these species.(Table 1).

a) **Herbs/Shrubs** :

1. **Aconitum ferox** wall. Ex Ser. (Indian Aconite/Bish)
Family : *Ranunculaceae.*

An erect herb upto 180 cm high grown in a temperate/alpine forests. The roots/tubers of this plant are used as medicine and as poison. It can be cultivated through seeds/tubers in moist hill slopes in the temperate/alpine zones of N.E. India.

2. **Acorus calamus** (Boch/Vacha)
Family : *Araceae*

It is a rhizomatous herb with linear blade like long erect leaves. The rhizome of this plant is used as medicine in diarrhoea, asthma, as flatulent and it improves mental ability. Megamind is a product of this plant. It can be cultivated in moist and marshy places through rhizomes.

3. **Justicia adhatoda** (Adhatoda zeylanica) (Boga Bahak/Vasak)
Family : *Acanthaceae*

It is a shrub with profuse branching, naturally grows in some localities. Nodes are swollen and flowers white. The leaves are used as medicine in cough, bronchitis, diarrhoea, etc. Glycodine, a cough syrup and vasak churna is prepared from the leaf extract of this plant. In Assamese it is said that if any body takes the juice of Vasak with honey in the morning (empty stomach) he will ever remain free from cough and stomach trouble.

4. **Andrographis paniculata** (Chirata teeta/Kalmegh)
Family : *Acanthaceae*

A small herb with very bitter taste. Whole plant is used in medicine in fever (malaria), jaundice, liver trouble, diabetes, stomach ailment and anthelmintic. It can be cultivated very easily in sandy loam soil through seeds. Kalmegh, an Ayurvedic and Homoeopathic medicine is prepared from this plant.

5. **Aquilaria agallocha** (Sachi/Agar)
Family : *Thymelaeaceae*

Agar is a tree with high potential value. It was found naturally in Assam and foothill areas but due to heavy illegal collection it is nearly extinct in wild. Agar oil is extracted from the wood of this plant which is used for perfumery products, tonic and carminative. It grows in well drained loam soil and can be cultivated very easily through seeds and cuttings.

6. **Asperagus racemosus** (Satamul)
Family : *Liliaceae*

A climber with @100 Nos of tuberous roots. These tuberous roots are used as medicines in abdominal pain of woman, fever and demulcent. It can be cultivated in any open areas or as under planting through seeds and tubers. Now a days this plant is also grown as ornamental plant.

7. **Bacopa monnieri** (Brahmi/Bojhidan)
Family : *Scrophulariaceae*

A runner (herbs) with profuse branching. Whole plant is used in illness, leprosy and skin disease. It is one of the raw material for the medicine, megamind a brain tonic. It can be cultivated through vegetative propagation in marshy areas.

8. **Centella asiatica** (Bor manimuni/Aghiniya)
Family : *Apiaceae*

It is also a runner herb. The plant is used in leprosy, tuberculosis and as tonic for brain. It can be cultivated through vegetative propagation in marshy areas.

9. **Mentha arvensis** (Padina/Pudina)
Family : *Lamiaceae*

An aromatic runner herb with profuse stems. The plant is used as stomachic, tonic to the kidney, liver and spleen. It can be cultivated very easily through vegetative propagation in open/ marshy areas.

10. **Ocimum sanctum** (Tulasi/Tulsi)
Family : *Lamiaceae*

An aromatic herb commonly found in every house of Hindu religion. Hindu people worships this plant. The leaves and seeds are used as medicine in cough, bronchitis, earache. Cough syrup is prepared from the extract of Tulsi. Some people use the leaves in tea also. Tulsi can be cultivated in any dry and open places, through seeds.

11. **Piper longum** and **Piper brachystachyum** (Pipli)
Family : *Piperaceae*

These are perennial shrubs or scandent. Sometimes it climbs on the host plant by clasping roots at nodes. It is a deoecious plant. The fruits are used as medicine for cough, bronchitis and rheumatism. Pepermint and peepamul is prepared. It is cultivated under shady, open or shady areas, but it need moist. So, it is preferred to cultivate under plantation. It can be propagated through the branch cutting or vegetative propagation.

12. **Piper nigrum** Linn. (Jaluk/Golmarich/Black pepper)
Family : *Piperaceae*

A climbing perenial shrubs with profuse branching. Fruits are used as medicine and spice. Fruits and roots are used as medicine and spice. Propagation through seeds and vegetatively, but universally prefers vegetative propagation. It can be cultivated in hot and moist shady areas as undergrowth.

13. **Rauvolfia serpentina** and **R. canescens** (Sarpagandha)
Family : *Apocynaceae*

Under shrubs with globose green fruits turning black when ripe. The root of *R. serpentina* used to extract serpentine which is used by pharmaceuticals for curing blood pressure, mental trouble. In case cf R. canescens, both root and fruits are used. It is very easy to cultivate in any open areas or under plantation through seeds.

14. **Tinospora cordifolia** (Amarlata/Giloc, Guloncha)
Family : *Menispermaceae*

It is a climber with white warty bark. The stem, leaves and fruits are used as medicine in dyspepsia, urinary diseases, fruits for rheumatism, young leaves for curing boils and swelling and aphrodisiac also. It can be cultivated in any open or moist areas through stem cutting or any vegetative propagation.

15. **Withania somnifera** (Aswagandha)
Family : *Solanaceae*

Herbs, leaves contain hairs with yellow flowers and acquiescent fruits orange in colour when ripe. Seeds are pale yellow. Roots and fruits are used as medicine in sexual debility, dropsy, and rheumatism and as febrifuge. It is one of the raw material for the medicine-Thirty plus, Gensex, Revital, etc. It can be cultivated in any open sandy or loam soil or under planting through seeds.

16. **Zingiber officinale** (Ada/Adrak)
Family : *Zingiberaceae*

A rhizomatous herb cultivated in the garden for spice as well as medicine. The rhizome is used as medicine in cough, bronchitis, fever, influenza, etc. It is cultivated in open and shady areas through rhizomes.

b) **Tree species :**

17. **Emblica officinalis** (Amlakhi/Amla)
Family : *Euphorbiaceae*

It is a tree with small leaves and greenish globose fruits. Fruits are edible and used as medicine in liver trouble, diabetes, jaundice, heart diseases, blood purifier. Some people use the fruit extract as hair oil. It can be cultivated in any open areas, through seeds. Triphala is a product of the fruit of this plant.

18. **Illicium Griffithii** Hook.f.& Thoms. (Lishi)
Family : *Illiciaceae.*

Lishi is amedium sized evergreen tree with star shaped fruits in subtropical and temperate forests. The fruit is carminative, improves appetite and use as spice. An essential oil is extracted from the fruits. It can be propagated through seeds and can be cultivated in sub-tropical/ temperate regions of N.E. India.

19. **Oroxylum indicum** (Bhatghila/Arlu)
Family : *Bignoniaceae*

Commonly known as Bhatghila a medium size tree with whitish bark and sword like fruits containing white round winged seeds. Bark and roots are used as medicine. Bark is used in liver trouble, stomachic, rheumatism and for tanning and dyeing. Root extract is one of the ingredient of Dasamoola. Root is used in treatment of T.B. and diarrhoea also. Bhatghila can be cultivated in any open wasteland areas through seeds.

20. **Taxus baccata** Linn (Himalayan Yew/ Manduriparni/ Talispatra)
Family : *Taxaceae*

It is an evergreen tall tree grown in temperate forests of Arunachal Pradesh, Manipur, Meghalaya and Nagaland. An anticancer drug called 'Taxol' is extracted from the leaves of this plant. It can be propagated through seeds and branch cutting and cultivation may ve adopted in private or community Jhumland in temperate region.

21. **Terminalia bellirica** (Bhomora/Bohera)
Family : *Combretaceae*

A tall tree upto 20 mtr. Timber is also usable. Fruits and barks are used as medicine in anaemia, leucoderma, asthma, bronchitis, leprosy and diabetes. This is one of the ingredient of Triphala. It can be cultivated in any open sloppy areas, wasteland etc. through seeds.

22. **Terminalia chebula** (Shilikha/Harra)
Family : *Combretaceae*

Commonly known as Shilikha, a tall tree with good timber value, fruit is edible and used as medicine. It is used in stomachic, carminative, taken in hi-cough, asthma, typhoid fever. The bark has diuretic and cardiotonic properties. Triphala, an Ayurvedic medicine is a product of this fruit. Shilikha can be cultivated in any open, wasteland area through seeds.

The medicinal plants like Sarpagandha, Pipli, Vasak, Aswagandha, Nayantara, Tulsi, Dioscorea, Smilax, etc. can be cultivated under these tree species as under growth for more production within a limited area and for shade loving plants, this will be more benefited.

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Table I

Sl. No.	Botanical name	Local name Assamese/ Hindi	Dabur India Ltd.	Nagar-juna Herbal Concen-trates	Other company	Price Rs/kg.
1.	Aconitum ferox	Aconite	+	+	—	1100.00
2.	Acorus calamus	Boch/Vacha	+	+	Baidyanath Ayurved Bhawan Pvt. Ltd. Patna - 1	100.00
3.	Adhatoda zeylanica	Boga Bahak/ Vasak	+	+	Baidyanath Ayurved Bhawan Pvt. Ltd. Patna - 1	800 to 10.00
4.	Andrographis paniculata	Chirata teeta/ Kalmegh	+	+	DBT Pharmaceutical Muzaffarpur, Bihar.	11.00
5.	Aquilaria agallocha	Sachi/Agar	+	+	Baidyanath Ayurved Bhawan Pvt. Ltd. Patna - 1	300.00 to 500.00
6.	Asperagus racemosus	Setomul	+	+	CSI Chem. & Pharm. Pvt. Ltd. 35A, Calcutta-700006	52.00
7.	Bacopa monnieri	Brahmi		+	Ganga Banaushadhi Bhandar, Vijaygarh Aligharh (UP)	50.00

Sl. No.	Botanical name	Local name Assamese/ Hindi	Dabur India Ltd.	Nagar-juna Herbal Concen-trates	Other company	Price Rs/kg.
8.	Centella asiatica	Manisuni/ Aghiniya	+	+	Baidyanath Ayurved Bhawan Pvt. Ltd. Patna-1.	23.00
9.	Mentha arvensis	Podina/Pudina	+		Gamber Laboratories, Bombay-400001.	120.00
10.	Ocimum sanctum	Tulasi/Tulsi	+	+	Baidyanath Ayurved Bhawan Pvt. Ltd. Patna-1.	16.00
11.	Piper longum/ brachystachyum	Pipli	+	+	Natural Drugs and Alkaloides Com. Pvt. Ltd. Delhi 110009.	124.00/ 60.00
12.	Piper nigrum	Black pepper	+	+	Local market	80/- (fruit) 30/-(roots)
13.	Rauvolfia serpentina/ canescens	Sarpagandha	+	+	Dolphin Laboratory, Calcutta-700020	60/= 30/= (Dry root)
14.	Tinospora cordifolia	Amarlata/Giloe	+	+	Baidyanath Ayurved Bhawan Pvt. Ltd. Patna-1.	7.95
15.	Withania somnifera	Aswagandha	+	+	Elfas Laboratory, Jaipur-302004	35.00
16.	Zingiber officinale	Ada/Adrak	+	+	Eisen Phar. Co.(P) Ltd. Pune-411004.	20.00
17.	Emblica officinalis	Amlakhi/Amla	+	+	Gambers Laboratories, Bombay-400001	8.00
18.	Illicium griffithii	Lishi	+	+	Local market	40/- 60/-
19.	Oroxylum indicum	Bhatghila/Arlu	+	+	Himalayan Drugs, Calcutta.	8.00
20.	Taxus baccata	Himalayan Yew	+	+	—	40/- 60/-
21.	Terminalia bellirica	Bhomora/ Bohera	+	+	Eros Pharm. Industrial Area, Bangalore-560010.	8.00 (fruits) 5.00 (bark)
22.	Terminali chebula	Shilikha, Harra	+	+	,, ,,	(Fruits) 8.50 (Barks)

DEVELOPMENT OF MEDICINAL PLANTS AS AN ECONOMIC VENTURE IN ARUNACHAL PRADESH : PROSPECTS AND CONSTRAINTS

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ABSTRACT

Arunachal Pradesh is a rich storehouse of medicinal plants. These include some unique and high demand species that have greater commercial potential. Ironically these vast resources have not yet been fully exploited for the economic benefit of the people of the state due to various constraints. The paper gives an overview of the floristic feature of the state and the traditional knowledge base of the people in relation to medicinal plants. It dwells in detail the prospects and constraints in developing medicinal plant as to a source of income and employment generation. It also highlights the marketing bottlenecks and suggests possible measures to overcome these.

INTRODUCTION

The northeastern state of Arunachal Pradesh is known for its rich medicinal plants wealth and local tradition of utilizing them. With the recent trend of falling back to nature there is greater interest on these plants that have potential of changing health and economy of the state. Despite being abundant in medicinal plants and its strategic advantages the state so far could not tape the potential due to various constrains and bottlenecks. We are not even aware of the prospects in this field. However, there have been attempts in the recent times to understand the medicinal plants in our state. As expected much of these are scattered and fragmentary. The paper tries to evaluate the prospects and constrains in developing this natural wealth in the economic progress of the state. Various aspects connected with this issue are discussed below.

Location

Arunachal Pradesh is situated at the extreme northeast corner of India, bordering Bhutan in the west, Tibet in the north, China in the northeast, Myanmar (Burma) in the east and the state of Assam and Nagaland in the south. It lies between 26° 28' & 29° 30' north latitude and 91° 30' & 97° 30' east longitude covering an area of 83,743 sq. km. It is a complex mountain system of eastern Himalaya with altitude varying from 100m in case of Siwalik formations from the plains of Assam to the Himalayas up to 7700m along the Tibet – China border. Hill ridges and valleys characterize the rugged terrain of the state. Numerous streams and rivers, dissecting the varied topography of the state, maintain the natural drainage system. The soil, in general, has high degree of acidity due to heavy rainfall and rich in humus with higher percentage of nitrogen.

Flora and vegetation

The state of Arunachal Pradesh is recognized as one of the hotspots in biodiversity (Rao & Hazra 1986, Rao 1994). The forest cover of the state is estimated to be 68,621 sq. km., which is about 61.54% of the total geographical area. A major part of it still enjoys primary forests though they are quickly eroding due to various biotic and abiotic factors. Arunachal Pradesh covers the largest part of the eastern Himalaya, which is strikingly different from the rest of the Himalayas as it receives higher rainfall, incidence of high temperature, scanty snowfall and high humidity etc. According to Kaul and Haridasan (1987), the state has more then twenty different forest types (Table-1) offering shelter to well over 6000 species of flowering plants (Rao, 1994). The region has since been recognized as a mega biodiversity hot spot.

Medicinal plants

The forest of Arunachal Pradesh is rich storehouse of important drug yielding plants, including many species of aromatic and spice plants (Hegde & Ingalhali 1988, Hegde 1988, Kohli 1990, 1992, Pandey & Rawat 1993). It is more spectacular and unique in case of high altitude medicinal plants that generally occur in the temperate belts in between 1800 to 3000m altitude. *Aconitum, Berberis, Bergenia, Coptis, Fritillaria, Gentiana, Gymnadaenia, Hypericum, Picrorrhiza, Podophyllum, Rheum, Swertia* etc. are some of the common ones that are exploited from these highlands (Mehta & Haridasan 1992). Availability of wide range of agroclimatic conditions has favoured the growth of warm loving tropical plants to chilling cold tolerant alpine herbs. So far more then 500 different species of medicinal plants have been catalogued from the state. With much of the area still unexplored larger proportion lie hidden in the vast untouched forests.

People and traditional knowledge

The state has over 25 major tribes and more then 100 sub tribes inhabiting the remote areas of the state. With their ingenious skill and close association with the plants growing around, they have accumulated vast knowledge relating to the utilization of these plants. Further, the region being located in the middle of some of the best-known medical systems like Indian system (Ayurveda) towards south, Tibetan and Chinese systems towards north etc., the indigenous knowledge base of the people of the region regarding the utilization of the plants is very high. Quite unfortunately their knowledge has not been properly documented or any serious attempt has been made to take advantage of this immense treasure of traditional knowledge.

Different ethnic communities of the state have been using these rich medicinal plants since time immemorial. They have well developed practices of treatment where natural products only are used as medicines. In almost every village there will be some elderly persons engaged in treatment of ailing population. They deliver effective healthcare to the otherwise isolated and remote villages in a much cheaper manner. Some of them are so popular in certain specialized treatments that people from far and wide travel to them for treatment. But this system is also in a dying state with the invasion of western medicines into these forbidden lands. Since there is no documentation of their information and practices we are bound to lose some very vital cure even before the world know it.

Village people generally use medicinal plants commonly available in and around their locality for their day-to-day requirements. Due to uncertainties associated with the availability of certain species at the time of requirement they prefer to cultivate those plants of their own. *Aconitum, Balsam, Coptis, Clerodendron, Impatiens, Piper, Pothos, Spilanthus, Stephania,* etc. are some such plants those are commonly cultivated. Their noble practice ensures sustainable utilization of this valuable germplasm. -

Trade

Some of the medicinal plants available in the state are also used in various other systems of medicine like – Ayurveda, Sidha, Unani, Homoeopathy and even in allopathy. Such species has got tremendous market potentials and are being extracted from wild in large scale without any consideration of sustainability of such exploitation and without the backup of any systematic cultivation/ regeneration practice. Much damage has already been caused to the high altitude species as the difficult condition limits the regeneration prospects of such species. This obvious has lead to unprecedented erosion of this valuable germplasm in the recent past. Following list (Table II) includes some of the species that have high demand in the market.

The trade in medicinal plants so far has been confined to one or two locations where middleman has access. There is no organized sector for this purpose and government intervention is almost negligible. Currently the local vendors or contractors arrange to collect drugs from wild using local labours at the lowest possible rates. The collected commodities are then dispatched to nearby Assam and destinations beyond. This is also practiced only for those high value high demand species. The other common to elsewhere plants are neglected mainly due to high transportation cost of these items. With increased demands some species get collected in such huge quantities at alarming rates that these species now survive with limited population only and are virtually being wiped out of the state. An example to cite would be the case of *Taxus baccata*, the Himalayan Yew.

Prospects

Arunachal Pradesh as already mentioned has large number of medicinal plants. Among them are a variety of species suitable for almost all agroclimatic conditions and widely differing habitat conditions. Thanks to its wide geographical area and physiographical features, there are more then enough land for cultivation of many of the indigenous and exotic species. The people of the state are mainly agriculture oriented and are experts in cultivation of plants in hilly terrain. The shifting cultivation practiced by the people also leave large area as fallows, which be profitably used for cultivation of medicinal plants.

We have different species that can be cultivated under forest plantations marshy areas, open areas, marginal lands, *jhum* fallows and west lands.

Taking advantage of the divergent habits of medicinal plants, multi tier cropping and inter cropping are possible. Such cultivation will not only add to the productivity but also provide a source of income in a perennial manner to the farmer.

Most of the herbaceous species have short gestation period and yield economic returns quickly. This is a feature, which is bound to attract villagers to go in for such ventures. In general forestry the case is different and the farmer has to wait for too long a period before the economic benefits could be reaped.

Though, currently medicinal plants are traded as raw material and in the crude form without any value addition within the state, the value addition can generate higher income and employment.

As larger share of medicinal plants are found in the interior villages and rural areas where employment avenues are limited, enterprises based on medicinal plants have potential for employment generation for rural unemployed women, in all fields like farming, tending, harvesting, post harvesting, value addition and related fields. This will also generate employment in allied sectors.

Since Arunachal Pradesh has a forest based economy, which has so far been timber based, there is a negative impact on the ecology of the forests due to well-known factors. Like other non-timber forest produce (NTFPs) medicinal plants based development if properly and scientifically done can highly reduce the pressure on our forests and lead to preservation of ecological balance.

Constraints

Although this region, as we have mentioned, is very rich in medicinal plants, ironically this rich potential is yet to be fully harnessed for the economic benefit of the state. Even with the availability of the favourable agro-climatic conditions there has not yet been any serious efforts in government as well as non-government sector for raising commercial plantations or scientific management of medicinal plants. There is no industry even to make crude drugs in the state. Such a sorry state of affair is due to the following constraints.

- Large scale and unscientific extraction of medicinal plants from wild.
- Threats posed on natural plant population by – habitat destruction due to deforestation, shifting agriculture, developmental activities like construction of Dam, Road, and Building etc.
- Lack of industry or marketing facility in the region.
- Lack of any agency/organisation to promote medicinal plant cultivation and its trade.
- A general absence of information on the distribution of medicinal plants.
- Uncertainties and market fluctuations associated with medicinal plant trade.
- Non-availability of quality planting stock.
- Inadequate R & D support and extension facilities.

- Lack of liberal financing avenues.
- Lack of proper post harvest technology and storing.
- Lack of professionals and skilled manpower.
- Lack of a database and information system for medicinal plants in the state.

Cultivation and marketing

From the foregoing discussion it is clear that for proper development of medicinal plants as commercial ventures the two most important sectors that need urgent attention are farming and marketing. Though other aspects like post harvest technology, industrial processing and value additions are also important.

We know that several species from this region are of very high commercial importance (table-2). For such species demand is there for large quantities and there is not a single man who can meet this demand by solely depending on wild resources. Moreover, quality of wild collected species often tends to be inferior due to inadvertent mixing of adulterants and other plants. The only alternative seems to be commercial farming in individual or co-operative sector. Realising this growing demand for these raw materials in the national as well as international markets some initiatives for raising demonstration farms have already been taken up by the State Forest Research Institute, Itanagar. Such activities are to encourage people to go for organised cultivation. They will do so if they are assured of the success of such plantations that may vary from place to place in species composition and product generated.

Since much of our areas are remotely placed and the transportation and communication infrastructure is poorly developed marketing is bound to have bottlenecks. To overcome this issue we need a cooperative movement in lines with the milk marketing societies and a medicinal and aromatic plant corporation to act as a nodal agency in agricultural financing and marketing of the produce. Such a corporation can also start with external collaboration processing and industrial units suitable to the state. This will develop market for some of the neglected medicinal plants of our state that otherwise would not have any market. But as a caution it may be mentioned that most of the corporations in the state are not in profitable position. Taking clue from their failures a professionally managed corporation with committed stuff can never be a losing venture. Much of the marketing problems can be addressed then.

CONCLUSION

Arunachal Pradesh is a sleeping giant in the field of medicinal plants. There is a too large resource base but too little exploited. The state has among its many species quite a few commercially viable medicinal plants, which have potential in commercial cultivation and entrepreneurial development. But before adopting these for such purpose a lot more need to be done. A detail survey needs to be made to assess the real potential and availability of raw materials. Silviculture and cultivation packages are to be developed for selected species. As there is scope for cultivation of tropical species and temperate ones of indigenous and exotic nature we have to establish performance and demonstration farms for important species that will act as extension centres and promote their cultivation by local people.

The single most important constrain in marketing of medicinal plants is the non-availability of large quantities of raw material of high demand species. The problem is aggravated due to the lack of a co-operative system and farming. To overcome this hurdle, it is essential to start medicinal plant co operative in the lines with the milk marketing co-operative. There is also a need for a full-fledged professionally managed medicinal and aromatic plant corporation in the state to cater to the over all development of medicinal plants.

There is also total lack of medicinal plant information system, database and marking linkages. These are to be urgently looked upon and concerted efforts are to be made to address these issues. Thus the state can be virtual giant in the field of plant-based health care. It cannot only enhance the economy with minimum damage to our environment but also add to the general health of the people.

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Table 1 : General Forest Types of Arunachal Pradesh.
(As per Champion and Seth 1968)

1B/C1	Assam valley tropical evergreen forests
1B/C2	Upper Assam. valley tropical evergreen forests
23/C1a	Assam alluvial plains semi-evergreen forests
23/C1/S1	Sub Himalayan. light alluvial semi-evergreen forests
3C/C3b	East Himalayan moist deciduous forests
3/1S2	Eastern hollock forests
8B/C1	East Himalayan sub tropical forests
9/C2	Assam sub tropical pine forests
11B/C1	East Himalayan wet temperate forests
11B/C1a	Lauraceae forests
11B/C1b	Bak oak forests
11B/C1c	High-level oak forests
11B/C2	Naga hill temperate forests
12/C3a	East Himalayan mixed coniferous forests
12/C3b	Abies delavayi forests
14/C2	East Himalayan sub-alpine birch/fir forests
15/C3	Alpine pastures
16/C1	Dry alpine scrub
16/E1	Dwarf juniper scrub

Table 2. Some important medicinal plants of Arunachal Pradesh.

Abroma augusta	Ulat kamal	S
Aconitum ferox	Aconite	H
Acorus calamus	Boch	H
Amomum subulatum	Bora elaichi	S
Andrographis paniculata	kal megh	H
Aquilaria agallocha	Agar	T
Bergenia ligulata	Pashanbhed	H
Clerodendrum colebrookianum	Naphaphu	S
Coptis teeta	Mishmi teeta	H
Costus speciosus	Kew	H
Dioscoria floribunda	Khamalu	H
Fritillaria cirrhosa	Yathun	H
Gaultheria fragrantissima	Winter green	H
Gentiana spp.	Pang-ghen	H
Gmelina arborea	Gamari	T
Gymnadaenia orchidis	Panch hath	H
Orchis latifolia	Salampancha	H
Gynocardia odorata	Chalmugra	T
Helinia elliptica	Chiraita	H
Hypericum spp.		H
Illicium griffithii	Lissi	T
Mesua ferrea	Nahar	T
Oroxylum indicum	Bhatghila	T
Panax sikkimensis	Ginseng	H
Panax pseudoginseng	Ginseng	H
Picrorrhiza kurroa	Kutki	H
Piper brachystachyum	Pipli	S
Piper peepuloides	Pilpli	S
Podophyum hexandrum	Podophylum	H
Rauvolfia serpentina	Sarpagandha	S
Rauvolfia tetraphylla	Sarpagandha	S
Rheum emodi	Rhubarb	H
Rheum nobile	Rhubarb	H
Rhododendron anthopogon	Dhah thee	S
Rubia cordifolia	Manjishta	S
Taxus baccata	Himalayan yew	T
Terminalia bellirica	Bohera	T
Terminalia chebula	Hilika	T
Tinospora cordifolia	Amarlata	S
Valeriana spp.	Jatamansi	H
Withania somnifera	Aswagandha	H
Zanthoxylum armatum	Timur	T

COMMERCIAL CULTIVATION OF TROPICAL ORCHIDS FOR INCOME GENERATION IN ARUNACHAL PRADESH

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ABSTRACT

Orchids are known for their unparalleled architecture, ornamentation and long lasting flower vase life and have attracted millions, for cut flowers and as indoor plants as well. Nowadays orchid cultivation has become a lucrative business and eco-friendly too. India is bestowed with numerous attractive orchid species and Arunachal Pradesh in particular harbours over 50% orchid species of the country. However, in the Northeast India, orchid cultivation for income generation is in its infancy. This paper deals with details of recommended tropical orchid hybrids, their cultivation techniques, harvesting and other technical inputs with monetary analysis.

INTRODUCTION

The term 'orchid' has its origin from the Greek word 'Orchid' meaning testicles referring to the paired underground tubers of European terrestrial orchid. Orchids belong to the family Orchidaceae with about 800 genera and over 20,000 species distributed all over the world, with over 30,000 varieties (Chadha, 1994). Further the ease with which they could be hybridized, has lead to the production of 1,00,000 man-made registered hybrids. Orchids are the most fascinating varied and beautiful of all flowers. So different are they from one another that at first glance it is hard to believe they are related. Some are large and showy, others are almost microscopic, some have delicate colouring, others have bold colours and markings that one automatically compares them to tropical birds or animals. Others are intricately immediately modified and complicated. It is as if nature, having invented the basic orchid theme, has, like a musician, played a very conceivable variation on that theme. In fact nature's imagination has gone far beyond the capabilities of human imagination. They are most pampered of the plants and have contributed significantly to the international trade in cut flower and ornamental potted plants. The flowers in some modern orchid hybrids have a shelf life of 8-12 weeks and surpass all other flowers in this respect.

A majority of the orchids known to the cultivation are native of tropical countries and occur in their greatest profusion in humid tropical forests of South and Central America, India, Sri Lanka, Myanmer, South China, Thailand, Malaysia, Philippines, New Guinea, Australia etc. The Brazilian Cattleyas, Mexican Laeleyas and Indian Dendrobium, Cymbidiums and Paphiopedilum have played a major role in the development of a large number of modern day hybrids.

In Western world, the orchid has become the flower for any ceremonial occasion i.e. from womb to tomb. There is a considerable demand for tropical orchids in the European, American and Arab market. Development of new hybrids and commercial cultivation of orchids has become lucrative industry in Europe, Hawaii, Australia, Thailand, Japan, Singapore, Sri Lanka and Kenya. Export of orchids can become a major foreign exchange earner for India provided proper impetus is given by all the developing agencies connected with orchids since our country is bestowed with favourable agro-climate for orchid growing.

INDIAN ORCHIDS

In India, the orchids are known since the Vedic period, and their early Sanskrit names include 'Amrta', 'Vanda', 'Vandika', 'Nakuli' etc. the reference of these plants are also seen in Sushruta Samhita and Charaka Samhita (600-220BC). Flowers of '*Rhynchostylis retusa*' are adorned by Sita the legendary heroine of Ramayana for sanctity and purity of womanhood (cf. Hegde, 1984). The same flowers are in use during Bihu festival the harvest celebration for almighty in Assamese culture.

India with a vast geographical area and varied climatic regions is rich in orchid diversity. While an exact estimate of the total orchid wealth in the country awaits botanical exploration in several virgin forests, the occurrence of 1,141 species in 166 genera (Sathish Kumar and Manilal, 1994). Nearly 60% of these are epiphytic in habit. Of these *Dendrobium* (106 species) and *Habenaria* (75 species) are respectively the largest genera with epiphytic and terrestrial habit (Vij, 1998).

ARUNACHAL PRADESH THE ORCHID PARADISE

Arunachal Pradesh due to its varied agroclimate regimes remain conducive for homeland of over 600 orchid species, which is more than 50 % of Indian orchids (Hegde, 1999). Arunachal Pradesh enjoys four different agro-climate zones throughout the year such as

Tropical: with high rainfall and humidity warm temperature ranging from 22-36^{0}C in summer and 10-25^{0}C in winter and elevation ranges 80-900M MSL.

SubTropical: moderate rainfall and humidity, cool temperature ranging from 15-30^{0}C in summer and 4-21^{0}C in. winter and elevation range 900-1800M MSL.

Temperate: with less rainfall, cool temperature ranging from 0-22^{0}C and elevation range 1800-2500M MSL and

Alpine: Essentially cool temperature ranging from 0-20^{0}C with snowfall and elevation above 2500M MSL.

Orchids are very specific to their agroclimate condition for healthier growing and producing good flower. Therefore before taking up orchid cultivation, the suitability of the planting materials to the prevailing site is essential. Following are the recommended list of orchids for growing in tropical climatic zones of Arunachal Pradesh such as all the foothills and valleys like Bhallukpong, Tipi, Seppa, Seijusa, Naharlagun, Itanagar, Dirang, Pashighat, Roing, Deomali, Namsai, Tezu etc.

Vandaceous orchids like *Aerides, Rhynchostylis*, hybrids of *Aranda, Mokara, Renantanda, Renades, Ascocenda*,

Cattleyas and their hybrids,
Dendrobiums like *nobile, crysotaxum, chrysanthum* and hybrids like

Dendrobium B.B. White, Walter, Oumae, Jaquelyn Thomas	White variety
Sonia no.16, no.17, no.28, Caesar, Laura, Lady	Bi colour
Yupadeevarn	Red and white
Intuwang, Nantavaran, Joab Kushima, Karen No.4	Purple
Venus, Nurashikin, Royal Pink, Pampadour, Sabin	Pale Purple
Mary Mak, Boonchoo Gold, Lowana Nioka	Yellow

MARKET PROSPECTS FOR TROPICAL ORCHIDS

Thailand is the largest producer of the tropical *Dendrobium, Vanda* and *Paphiopedilum* cut flower but significant quantities are now being produced throughout Asia mainly Sri Lanka and Singapore. Italy is the single largest consumer of both tropical and temperate orchids in Europe. Italy imports nearly 63 million stems of tropical orchids from Thailand and 750 thousand stems from Singapore almost throughout the year. Germany is the second largest importer of orchids in Europe importing nearly 29.7 million stems mainly from The Netherlands (16.6 million stems), Thailand (11.7 million stems) and Singapore (996 thousand stems). In Germany the Thai orchid range between 0.29-0.50 US$ for Dendrobium 'Madam Pampadour' and 0.41-0.65 US$ for Dendrobium 'Sonia'. Holland depends on Thailand for its requirement of tropical orchids. In total Holland imports nearly 17.5 million stems from Thailand (14 million stems), Singapore (1.9 million stems) and New Zealand (0.22 million stems). The United States of America is one of the major destinations for the orchid produced worldwide. It imports nearly 16.4 million stems of tropical orchids. Dendrobium from Thailand (14 million) followed by Singapore (9289 thousand stems), New Zealand (37.142 stems), Jamaica (44,611 stems), Costa Rica (23,660). Besides these the USA also imports non-Dendrobiums mostly from Thailand (3.8 million stems), Holland (1.5 million stems) etc.

A birds eye view of the present world market of orchids indicates that the demand for orchids is fast expanding and there is a great scope for new entrants like India which has all suitable agroclimatic conditions. Especially in Arunachal Pradesh the aforementioned tropical climatic zones are suitable for tropical orchid farming and market them at the competitive prices in the international market. Over the last 9 years after inception of Orchid Society Arunachal (OSA) the awareness of orchid amongst the people has increased tremendously. With the initiative action by State Forest Research Institute, Itanagar and its orchid Research Station at Tipi, utilizing the external funds it has been able to develop few Cymbidium orchid farms (Hegde *et al.*, 1996). Initially, OSA has arranged the initial domestic marketing linkage to Delhi and now the individual farms have their own market linkage. Thus with addition of more orchid farms growing tropical orchids, the marketing could be better linked in co-operative manner to fetch better price.

TROPICAL ORCHID CULTIVATION TECHNIQUE

Tropical orchids are cultivated commercially in clay pot or plastic pot. The required potting mixtures of brick bat and charcoal. However, proper aeration of the potting mixture should be ensured for healthy orchid growing. The pots should have holes at the bottom and around the pot so as to drain off the excess water.

Plants do not keep their accounts, of course, but if balance sheets were published for them, they would be quite similar to as receiving interest money from the bank. If one spends more than one earns, result is ending up in debt. If one earns more than one spends, there are savings, and economically savings means better living. The earning of plants is the food they make, and their spending is the food they use for energy. Their savings go into growth and flower production, with reserve kept towards launching the next season's growth. Therefore, for a successful orchid farmer, maintenance of proper light, temperature, ventilation, relative humidity, feeding fertilizers, protection from disease are the major factors.

Light: Tropical orchid prefers 25 to 30 kilo lux light for healthy growing, the same light intensity could be maintained by providing agroshade netlon of 50% shade.

Temperature: Tropical orchid grows luxuriantly in the day temperature 22^0-34^0C and night temperature 16^0-22^0C. The required temperature range is already prevalent in the foot hill areas of Arunachal Pradesh.

Humidity: Relative humidity required for tropical orchid is of 65-80%. Lesser the humidity will dry up the plants and excess humidity will harbour the disease. Therefore keeping a hygrometer in the green house is advisable. If the humidity falls in the green house immediate damping of floor is helpful.

Ventilation: Sufficient air circulation is required for healthy growing of orchids in the green house. For better ventilation the green house should be at least 3.5m height. If any grower can provide exhaust fan that will be excellent for ventilation.

Watering: It is very important to use good quality clean water with low dissolved salts and free from sodium and chloride. If the water is used from rivers and lakes it has to be filtered through sand filters before using. The pH of water should be around 5.5 to 6.0. If alkaline it should be treated with acid. Rainwater is the finest source of water for orchids and on a small scale this could be collected and stored.

Fertilizers: Orchids grown in pots, dilute liquid manure may be applied but not until root growth has begun. A weak liquid solution of 20:20:20 (NPK) at about 0.2% of water once or twice a week in summer and 0.1% concentration in winter. It should be applied in early morning after regular watering to prevent washed off.

Plant protection: A preventive measure for plant protection from disease may be taken by following spray programme. Such as-

i) Apply Kethane once in 15 days interval in dry season and once in a month in other season @2ml per liter water to prevent spider mites.
ii) Apply Lannate every month @1 ml per liter to prevent insect pest.
ii) Apply Metaldehyde and Snailkills to prevent snails and slugs.
iv) Apply Captan or Dithane once in a week during rainy season and once in 15 days in other season @2g per liter to prevent fungal disease.
v) Apply Agromicin or Paushamycin @0.25g per liter once in 4-5 week to prevent bacterial disease.

All these preventive spray should be applied using fine nozzle sprayer early in the morning or late in the evening to avoid washed off.

Harvesting: This is very important operation and grower should have thorough knowledge about flowering behaviour of the kind of orchids planted for cut flower production. Proper time, stage and method of harvest will determine the quality of the produce. In general. orchid flowers do not mature until 3-4 days after they open. Flowers cut prior to their maturity may wilt very quickly. Harvesting should preferably be done in the evening. Stems are cut with sharp and sterilised knief and they are immediately dipped in the sterile water to check any air blockade at the cut end. Thereafter, the stems are cleaned gently with absorbent cotton dipped in calcium hypochlorite (1% available chlorine) and graded according to the quality of the cut flower like number of flower per stem, health of the flower and the scape strength etc. At the cut end of the stem a thin absorbent cotton wetted in sucrose solution should be placed and covered with polythin pouches. The last step is very essential because on the transportation the sucrose will provide minimum required energy to maintain good health of the flowers. Thus prepared stems are placed in the corrugated box of specified sizes like 70cmx20cmx15cm with a polythin sleeves to reduce mechanical during transportation. Now the cut flower is ready for transportation.

Economics: Commercial orchid farming whether in small or large scale is cost intensive and profitable at the same time with minimum space. Detailed project economics for 1000 Dendrobium plants with 160 m^2 of land is given in table 1,2 & 3. It is expected that with proper publicity and technical support, people will develop interest in farming orchids and eco-friendly trade. Financial assistance for entrepreneur is available from NABARD, APEDA, NHB, NEDFI etc. for promotion of floriculture.

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Table 1. Estimate of *Dendrobium* orchid farming for 1000 plants (160 sq. m.)

Sl. No.	Particulars	Year-wise expenditure (Rs.)			
		I	II	III	IV
1.	Planting materials @Rs.100 for 1000nos.	1,00,000			
2.	Clay pots @ Rs.10 for 1000 nos.	10,000			
3.	Potting mixtures @Rs.5 for 1000 nos.	5,000			
4.	Agroshade house 16mx10mx3.5m	60,000			
5.	Chemicals and fertilizers	12,000	12,000	12,000	12,000
6.	Minor equipment e.g. pruners, secatures, spray machine	3,000			
7.	Contingencies	10,000	5,000	5,000	5,000
	Total	2,00,000	17,000	17,000	17,000

Table 2. Yield analysis

Sl. No.	Particulars	Years wise yield					
		II	III	IV	V	VI	VII
1.	Spike per plant	2	3	4	6	8	8
2.	Total spike (90%)	1,800	2,700	3,600	5,400	7,200	7,200
3.	Total keikis (vegetatively multiplied plants)	200	1,000	1,000	-	1,000	1,000
4.	Total cost of spike @ Rs. 15/- at farm gate	27,000	40,500	54,000	81,000	1,08,000	1,08,000
5.	Total cost keikis @Rs.50/-	10,000	50,000	50,000	-	50,000	50,000
	Total outcome (4+5) Rs.	37,000	95,500	1,04,000	81,000	1,58,000	1,58,000

Table 3. Repayment of bank loans

Sl. No.	Particulars	Year wise down payment (Rs)						
		I	II	III	IV	V	VI	VII
1.	Bank loans	2,00,000	-	-	-	-	-	-
2.	Bank interest (15%)		30,000	34,500	37,425	32,539	28,420	13,183
3.	Cumulative outstanding (Rs.)	2,00,000	2,30,000	2,49,500	2,16,925	1,89,464	87,884	1,21,066
4.	Gross return		37,000	95,500	1,04,000	81,000	1,58,000	1,58,000
5.	Maintenance cost (Rs.)		17,000	17,000	17,000	17,000	17,000	17,000
6.	Repayment of bank loan (Rs.)		15,000	70,000	80,000	60,000	130,000	1,21,066
7.	Net return (Rs.)	-	2,000	8,500	7,000	4,000	11,000	36,934
8.	Total Net return after 7 years 69,434							

INTENSIVE CULTIVATION OF ORCHIDS IN ARUNACHAL PRADESH
-A STEP TOWARDS SELF EMPLOYMENT

Rabindra Kumar* **and S.P.Singh****

ABSTRACT.

Limited financial and human resources coupled with demographic constraints diverse geographic, climatic, socio-economic and cultural conditions, remoteness, and even inaccessibility of the areas, there is a need of development of special skills and knowledge at various levels of personnel engaged in developmental process. Like dairy cooperative movement of Gujrat, Haryana & Punjab and Orchid Growers Societies running in Kerala; Arunachal Pradesh can also make a revolutionary beginning in field of orchid cultivation. Initially linkages of small orchid societies with some schemes of district administration like DWCUA/ DWCRA (Development of Women and Children in Urban Areas /Rural Areas) can prove to be a major break through in the economic development of the state.

INTRODUCTION

Recent imposition of ban on tree permit operation and restrictions on exploitation of major forest produce by the Apex Court have caused a great deal of unemployment to the local people of Arunachal Pradesh over last few years. Excellent agroclimatic conditions available for orchid cultivation throughout the state can fulfill the economic requirement of the inhabitants besides providing the employment to the local people.

In view of the limited financial and human resources coupled with demographic handicaps, diverse geographic, climatic, socio-economic and cultural conditions, remoteness and even inaccessibility of the areas, inability of the centralised services to reach all these areas, there is a need of development of special skills and knowledge at various levels of personnel engaged in developmental process, so that they could become effective media of delivering goods and also of attending to activities related to community /society involvement in entrepreneurship development (Satush 1997).

The Most critical need is to convince the community for a behavioural change, involving change in outlook that is shift from traditional perception and generating consciousness about importance of participation and involvement in the process of development so that the assets created

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under various Govt. schemes are perceived as their community assets and utilized optimally (Maheshwari, 1985, Reddy and Mudduri1997).

The orchids are perennial herbaceous plants, which produce flowers of high ornamental value. They are mainly used as cut flowers. The great variety in colour, perfumes, size, shape of flowers and certain strange and exotic ambience associated with the orchids make them especially attractive. Beauty and fragrance apart, some hybrid orchids have the maximum vase life of 8-12 weeks. Cymbidium an important member of the group, is one of the top ten cut flowers in the international trade (Hegde, 1999). While cymbidiums are grown in temperate climatic conditions, Dendrobiums, Phalaenopsis and Vandas are grown in warm humid tropical areas for cut flowers production (Hegde & Saikia 1998). Orchids are also grown as pot plants(Hegde 1984). Some of them are valuable as medicinal plants since they are source of a variety of alkaloids. Famous Vanilin, extracted from the Vanilla orchid, is a popular flavouring agent. They could also be a source of natural fungicides in future.

MARKETS AND EXPORT POTENTIALS:

In western world, the orchid has become the flower for any ceremonial occasion. There is considerable demand for tropical orchids in the European, American and Arab markets. The major importers of orchids are the USA, Japan, Hongkong, and EEC. (Countries namely Italy, the Netherlands, Germany, France and U.K.)

Japan is one of the biggest importers of orchids. An estimated 600 ha. orchid farm in Thailand, Singapore, Malaysia and Indonesia meets much of the Japanese import demand.

The gross value of orchid sales in the USA amounts to us $ 50-60 million. Thailand accounts for 98 percent of the total import of Dendrobium orchids by USA.

India has been mainly exporting native species of orchids. In accordance with the Convention on International Trade in Endangered Species of Fauna and Flora (CITES), the trade in native species of orchids from wild sources has been banned. India's export of the orchid flowers is yet to reach a sizeable figure. India exports orchid flowers to Europe, Hongkong, Japan and Australia. However, India's potential for the export of orchid flowers is rated as high the export committee appointed by the APEDA (Agricultural and Processed Food Products Export Development Authority) identified orchids as one of the flowers suitable for export production. The Eapen George Committee appointed by the Union Commerce Ministry recommended Rs. 30.00 crore project for the development of the orchid industry in India.

Though India's present orchids export is meager, its future potential is high in view of the following reasons:

- A large number of orchid species grow naturally in the congenial climate of India. The North East and South West regions are considered as two important areas for the orchids. Of the numerous species of orchids only a few can be successfully grown in the plains.

- The climatic conditions may permit the cultivation of the orchids; either in the open or in simple green house, so as to export them round the year.
- The cheap labour, land, and input cost enable Indian orchids to be cost effective.
- India is strategically located between Middle East, Far East, & EEC markets.
- Decreasing availability of land areas, due to rapid urbanisation in south East Asia countries, which are the major exporters of orchids, is opening up the possibility of shifting the orchid production centers to south Asian countries.
- The recent economic liberalisation initiated by the Union Govt. and emphasis on the promotion of agri-export and the development of infrastructure have created congenial conditions for setting up of export oriented units of orchids.
- A domestic market of orchids is developing fast which can absorb non-exportable surplus.

AGRO-CLIMATIC REQUIREMENTS:

The warm, humid and a 'jungle' like situation provides congenial conditions for the growth of orchids in nature. The northeastern region of India abounds in various types of orchids. Most of the commercially important orchids thrive well under temperatures ranging from 10°C to 32°C, humidity from 50% to 85%, light intensity from 2000 to 6000 foot candles. A 10°C variation between day and night temperature is preferred. For cymbidium orchids, which thrive under cooler regions, night temperature of 10°C and day temperature of 22-25 °C are considered as ideal. Cultivation of the orchids should be under conditions, which are similar to their natural habitats so as to attain high productivity and quality. The N.E. region particularly Arunachal Pradesh is suitable for Dendrobium, Cymbidium, Paphiopedilum and Phalaenopsis orchids (Satush, 1997).

SITE SELECTION

It is possible to produce the orchids commercially in various locations of the states with moderate climate control facilities. The following factors should be taken into account for selection of the site.

- Cost of production.
- Cost of transportation
- Quality

It is to be borne in mind that only the products with reasonably good quality at the national or internationally competitive price will be saleable in the markets abroad.

The availability of water supply, labour and infrastructural facilities such as electricity, road, and communication are other factors, which should be taken into account for site selection.

MATERIALS AND METHODS FOR ORCHID CULTIVATION

The essential components for hi tech orchid cultivation/ farming for domestic as well as abroad market are the following:

1) ***LAND*** : Land would be required for the construction of green house, storage, grading cum packing house, etc.

2) ***ORCHID HOUSE*** : Few orchids such as Aranthera, Vanda, Arachnis and Aranda are grown in the open field on trellises, the majority of the orchids prefer shady situation as prevalent in their natural tree habitats.

The important commercial orchids, which can be successfully grown in Arunachal Pradesh particularly Dendrobium and Cymbidium, need about 50-60% lath shades. Therefore, orchid houses are essential for their commercial activities. The orchid houses may be erected on bamboo/wooden/ iron/RCC poles. Benches 1.2 m wide, may be constructed at a height of 0.75 m from the ground level. Shading nets made of High Density Poly ethylene (HDPE) may be used as roofing material. Benches would serve as platform for orchid pots. All sides may remain open. Instead of HDPE shading nets, locally available materials such as bamboo splits, live creepers, supported by wire nets, coconut husks and date palm leaves can be used.

3. ***IRRIGATION SYSTEM*** : Water supply system is essential for successful production of orchids. Orchid pots should not be allowed to dry and high humidity of 60-90% should be maintained.

4. ***GRADING CUM PACKING PLACE*** : For grading and packing of harvested stems/flowers a ordinary bamboo type shade place is required. Since the main production period is from September to March when rain is plenty.

5. ***COLD STORE FACILITY*** : It may not be possible to arrange transshipment of the orchid stems/cut flowers immediately after harvest due to volume insufficiency or when the vehicle is in transit. Therefore it would be better all the small grower cooperative/beneficiaries should be provided with cold storage facility at the central place, so as to maintain the quality of the flowers.

6. ***REEFER VAN*** : To avoid any break in the cold chain from the harvest to the floristic shop, a refrigerated van should be provided to cooperative for carrying the orchid stems from the farm gate/cold store to the airport.

7. ***SOURCE OF PLANTING MATERIAL AND TECHNOLOGY***: Since the proposed technology is innovative in terms of the existing status of the orchid cultivation in North-East Region and Arunachal Pradesh in Particular, engagement of Indian consultants or eminent scientists should be made as per the requirement. State Forest Research Institute, Itanagar is having a full fledged Orchid Division and is pioneer in orchid research in the North-Eastern Region. It has already developed few entrepreneurs and Orchid Growing Societies in Arunachal Pradesh and some are likely to be developed very shortly.

8. ***MARKETING STRATEGY*** : The entrepreneurs of large size units and cooperatives usually enter into buy back arrangements with their local and overseas collaborators. This usually includes import of costly equipments, plant and machinery for better know how and foreign technicians. Entrepreneurs should develop their overseas markets through visits, publicity, distribution of samples etc.

As regards sale in the domestic market, the entrepreneurs may have tie up with hotels, florists' shops in big cities.

CURRENT SALE PRICE :

The price of the orchid flowers depends on the length of spikes, number of flowers per spike, size of flowers, colour, freshness, market, season of marketing, country of origin etc. In India, A.V. Thomas and company of Cochin, Natural Synergies India Ltd, Chennai, Madhu Farms, New Delhi etc. are buying the orchids at a medium average price of Rs. 10.00 and Rs. 20.00 per spike for the Dendrobium and Cymbidium orchids respectively.

ORCHID CULTIVATION AS A COOPERATIVE MOVEMENT:

Like Dairy cooperative movement of Gujrat, Haryana & Punjab and orchid growers society/cooperative movement running in Kerala, Arunachal Pradesh can also mark a grand beginning by making some self help groups (SHGs). There are a number of schemes under the state administration in which there are so many provisions to help rural and urban societies. Linkages with these programmes with orchid growing will be best suited and can prove to be a major break through in the development process of the state. Such schemes are known as Development of Women and Children in Urban Areas (DWCUA)-*implemented by Department of Urban Development through DUDAs* (District Urban Development Agencies) and Development of Women and Children in Rural Areas (DWCRA) *implemented by Department of Rural Development through DRDAs* (District Rural Development Agencies).

DWCRA/DWCUA :

Where the DWCUA/DWCRA group sets itself up as a thrift and credit society, in addition to its other entrepreneurial activity, the group/thrift and credit society shall also be entitled to a lump sum grant of Rs. 50,000 as revolving fund at the rate of Rs. 1000 maximum per member. This revolving fund shall be available to a simple thrift and credit society also even if the society is not engaged in any project activity under DWCUA/DWCRA(Varlakshmi, 1997). This revolving fund is meant for the use of the group/society for purposes like:

1. Purchase of raw materials and marketing
2. Infrastructural support for income generation and other group activities.
3. One time expense of child care activity. Recurring expenses like salary for staff etc. will not be payable.
4. Expenses not exceeding Rs. 500 to meet travel costs of group members for visit to banks, markets etc.
5. Where an individual member of a thrift and credit society saves at least Rs. 500 in a fixed deposit for 12 months with the society she will be entitled to a subsidy of Rs. 30 to be paid on her behalf towards a health/life/accident/any other insurance scheme for herself. Moreover, in cases where the member saves at least Rs. 750/- in fixed deposit in 12 months, she will be entitled to subsidy of Rs. 60 at the rate of Rs. 30 for the member herself and either Rs. 30 for her husband towards health/life/accident/and other insurance or Rs. 30 for any minor girl child in her family for health/accident insurance. These expenses may also be debited to the revolving fund and any other expense allowed by the state as being necessary in the group or society interest.

A DWCUA/DWCRA, group/Thrift and credit society shall be entitled for payment of revolving fund not earlier than one year after its formation. In other words, only such a body in existence and functioning for at least one year shall be eligible for payment of the revolving fund. The decision whether a group has been in existence and functioning for more than one year shall be taken on the basis of examination of the record of the group as regards the number of meetings held. The collections made from members towards group savings, the regularity of collection, the role of the group in capacity building or training of its members, etc. (Varlakshmi, 1997).

The DWCUA/DWCRA group society shall be entitled to a subsidy of Rs. 1,25,000 or 50% of the cost project whichever is less.

This is distinguished by the special incentive extended to urban/rural poor women who decide to set up self-employment ventures in a group as opposed to individual effort. Groups of urban/rural poor women shall take up an economic activity suited for their skill training, aptitude, and local conditions. Besides generation of income, this group strategy shall strive to empower the urban/rural poor women by making them independent as also providing a facilitating atmosphere for self-employment.

To be eligible for subsidy under this scheme, the DWCUA/DWCRA group should consist of at least 10 urban/rural women. Before starting income generating activity the group members must get to know each other well, understand the group strategy, and also recognise the strength and the potential of each member of the group. The group shall select an organiser from amongst the members. In addition every effort will be made to encourage the group to set itself up as a thrift and credit society.

Also, NABARD (for rural areas) and SIDBI(for urban areas) are having some provisions to help the self help groups/societies for undertaking the such type of economic/ entrepreneurship activities.

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SOIL CHARACTERISTICS OF SOME CANE (RATTAN) BEARING AREAS IN ARUNACHAL PRADESH

- A PRELIMINARY INVESTIGATION

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ABSTRACT

Cane occurs naturally as an undergrowth in evergreen, semi-evergreen, wet evergreen and to some extent in moist deciduous tropical and subtropical forest in Arunachal Pradesh. Very little is known about the soil properties of cane bearing areas. This paper attempts to highlight the physical and chemical properties of soil from natural cane bearing areas in Arunachal Pradesh.

INTRODUCTION

In India rattans which is one of the most important group of non timber forest produce are mainly confined to three major regions viz., in the Western Ghats of peninsular India, North-East India and Andaman and Nicobar Islands (Lakshmana 1993). These plants are popular as important raw materials for the furniture industry all over the world and most valuable for forest dwellers as they furnish raw materials of daily use, for arts and crafts and importantly livelihood. Out of 5 genera and 60 species found in India, Arunachal Pradesh alone accounts for 4 genera and 17 species. Although rattan concentration more in tropical forest, a few species viz. *Plectocomia himalayana* and *Calamus acanthospathus* are found in subtropical forest also. Cane proliferates in areas of abundant and well distributed rainfall, where the soil is fine clay and rich in humus (Balagopalan *et. al.* 1992). But the knowledge about the soil properties required for cane growth are very scanty (Backman & Brady, 1967). This paper highlights the soil physical and chemical properties of natural cane growing areas in Arunachal Pradesh where regeneration was found to be more.

MATERIALS AND METHODS

Composite soil samples were collected during winter season at 0-20 cm depth from different cane bearing areas of Arunachal Pradesh and analysed in the laboratory by standard methods (Jackson, 1967, Walkley & Black, 1954).

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RESULTS AND DISCUSSION

Physical and chemical properties of soil from cane bearing areas in Arunachal Pradesh are shown in Table 1.

Table 1 : Physico-chemical properties of soil from cane bearing areas in Arunachal Pradesh.

Location	Cane sp.	Colour of the soil	Clay %	Salt %	Sand %	Textural class	Water holding capacity %	pH	Electrical conductivity (m mhos/cm)	Organic carbon %	Available nitrogen (kg/ha)
Routa (West Kameng)	*Calamus leptospadix*	Yellowish brown	16.1	32.1	51.8	Sandy loam	56	5.65	0.51	3.31	148.9
Lama camp (West Kameng)	*Plectocomia himalayana*	Yellowish brown	33.1	41.1	28.8	Clay-loam	64	6.22	.088	1.87	183.2
Sessa (West Kameng)	*C. flagellum* *C. erectus*	Dark reddish brown	13.1	25.1	61.8	Sandy loam	58	6.68	0.54	.89	138.2
Khuppi (West Kameng)	*C. flagellum* *C. gracitis* *C.leptospadix*	Dark reddish	14.6	27.4	65.6	Sandy loam	59	6.36	0.13	1.64	150.8
Tipi (West Kameng)	*C. flagellum* *C. erectus*	Brown	26.2	37.7	36.1	Loam	50.	5.28	.08	4.87	140.5
Khari (East Kameng)	*C. flagellum* *Daemonorops jenkinsianus*	Dark reddish brown	14.6	51.3	34.1	Silt loam	53	5.20	.067	5.26	160.8
Haldibari (Namdapha)	*Zalacca secunda* *C. flagellum*	Dark yellowish brown	19.6	41.3	39.1	Sandy loam	56	5.33	.23	1.64	172
Deban (Namdapha)	*C. leptospadix* *C. flagellum* *Z. secunda*	Dark yellowish brown	23.6	40.3	36.1	Clay loam	60	5.25	0.36	1.58	225
Kamlung (Namsai)	*C. leptospadix*	Brown	15.6	36.3	48.1	Loam	49	5.58	0.41	0.43	148

It is evident from the results that cane prefers all type of loamy and dark colour soil, which can absorb more heat and water than light soil. Water holding capacity of soils from cane bearing areas varies from 49 to 60%. The pH range of the soil varies from 5.2 to 6.68 which indicate that canes prefer strong to medium acidic soil condition. Electrical conductivity, which is the measure of total dissolved salts ranges from 0.088 to 1.64 m mhos/cm. Organic matter is a very important factor which regulates soil fertility, was found rich in cane bearing areas i.e. 0.43% to 5.26%. It is found from the investigation that the total available nitrogen varies from 38.2 kg/ha to 65 kg/ha of natural cane bearing areas in Arunachal Pradesh.

CONCLUSION

Thus it can be summarized that canes prefer dark colour as well as all types of loamy soil having moderate water holding capacity. Strong to medium acidic soil with rich in organic matter and available nitrogen are required for good regeneration of canes.

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NEWS AND NOTES

OSA HOLDS MILLENIUM'S FIRST FESTIVAL OF FLOWERS

Orchid Society Arunachal (OSA) organised the new millenium's first Festival of Flowers and 4th in the series, on 19-20th February, 2K coinciding with statehood day celebrations on 20th February. The grand event was successfully organised under the patronage of govt. of Arunachal Pradesh, NGOs and the members of OSA highlighting the importance of orchids in augmenting floriculture development in the state.

As a part of the programme, garden competitions were held on 17-18th Feb, 2k within the capital complex Itanagar. On 19th Feb. 2K there was flower show competition under various categories, classes and sections. As many as 207 competitors participated and the best among various sections were awarded prizes.

Smt. Pomaya Mithi wife of the Hon'ble Chief Minsiter, Arunachal Pradesh Shri Mukut Mithi, inaugurated the festival. The inaugural function was attended by large number of VIPs including His Excellency the Governor Shri Arvind Dave, Smt. Meenakshi Dave, Honble Chief Minister Shri Mukut Mithi accompanied by his cabinet colleagues and Shri Samar Singh Secretary General, WWF-India as the Guest of Honour. The VIPs evinced keen interest in flowers and plants displayed. Realizing the potentials of floriculture and tourism in the state, Madam Mithi called upon the people to make all out efforts in tapping this potential.

During the two-day long exhibition, there were technical sessions with invited lectures and demonstrations on orchid cultivation, floriculture and assistance schemes offered by various organizations. Further, there were photography competition on "**Flowers, nature and culture**" in addition to drawing and painting competition for school children of various groups on the theme "Flowers and plants for healthy environment".

The valedictory function was held on 20th Feb. 2K at 2 p.m. The function was graced by Smt. Meenakshi Dave as the Chief Guest and Shri Samar Singh, Secretary General, WWF-India as the Guest of Honour. The function was also graced by His Excellency the Governor Shri Arvind Dave, Shri Mukut Mithi Chief Minister and Smt. Mithi, Hon'ble Ministers (Horticulture, Tourism, Sports), in addition to senior officers of govt. of Arunachal Pradesh besides large gathering. Smt. Dave gave away the prizes to the winners of various events and gave a message to the people of Happy Flower Growing. Shri Samar Singh who addressed the gathering, mentioned that conserving orchid and growing them was conserving forests as these plants depended upon the trees/forests. Therefore, all care and attention should be given to orchid conservation, cultivation and propagation for healthy environment and prosperity.

TRAINING ABROAD

Dr. Rabindra Kumar, IFS, DCF (HQ) in the office of the PCCF attended a training course on conservation and sustainable use of preserved forests at Forest Training Institute, Govt. of Japan, Tokyo organised by Japan International Co-operation Agency. The Training was during January to

March 2000, in which Dr. Rabindra Kumar presented papers on forestry in northeastern India, particularly in the context of Arunachal Pradesh. He could gain rich experience about the Japanese afforestations programmes, their plantation technology and reforestation of logged over forests.

Shri Santosh Kumar, IFS, DFO Banderdewa Forest Division undergone a training in planting stock improvement at the Oklahoma State University, Still Water, USA for three months during October to December 1999. His training was sponsored by the ICFRE under the FREE (Forestry Research Education and Extension) Project.

NEW DIRECTOR JOINS STATE FOREST RESEARCH INSTITUTE

Consequent upon the transfer and posting of Shri M.L. Deori, IFS, Director SFRI as Conservator of Forests, Southern Circle, Deomali, Shri Ajai Saxena took over the charge of the Director SFRI. Shri M.L. Deori who had been the Director for the past over 3 years had an eventful career. Shri Saxena has a wide exposure to tropical forestry/ management, wild life research and conservation. Prior to joining Arunachal Pradesh, he has earlier served in Andaman and Nicobar Island and worked as Faculty Member in the Wild life Institute of India in the Faculty and Wildlife Management. He also has the distinction of being a summer team member in XVI Indian Scientific Expedition to Antarctica during 1996-97.

S.F.R.I. RESEARCH FELLOWS COMPLETED THEIR PH.D. WORKS.

Shri Sunny Thomas who has been a Research Fellow working on the project entitled **" Studies on Taxonomy, distribution and utilization of Rattans/canes in Arunachal Pradesh"**. funded by DST Govt. of India has successfully completed his Ph.D. work and submitted his thesis to the Gauhati University for award of Ph.D. Degree. He worked under the supervision of Dr. K. Haridasan, Systematic Botanist. This work has brought out 10 new records of canes to the state and a new species. It also highlights the conservation and ethnobotanical aspects.

Similarly, Shri S.K. Sinha Research Fellow working in a DBT sponsored project entitled " Micropropagation and *in vitro* induction of polyploidy of some commercially important vandaceous orchids in Arunachal Pradesh" under Dr. S.N. Hegde has completed his Ph.D. work entitled **"In vitro studies on the effect of gamma irradiation and colchicine treatment on *Renades 'Arunodaya'* hybrid and its parent species *Aerides rosea* Loddiges ex. Paxt. (A. Williamsii Warn) and *Renanthera imschootiana* Rolfe"** and submitted his thesis to the same University for award of Ph.D. degree. Dr. S.N. Hegde was the research supervisor for Shri Sinha. The work deals with induction polyploidy, action of mutagens on some hybrids developed in the SFRI like *Renades Arunodaya* and its parent species.

JFM WORK SHOP ORGANISED.

Department of Environment and Forests in collaboration with NAEB Regional Office, Shillong jointly organised a training workshop on Joint Forest Management at SFRI Itanagar from 24-27 February, 2000. Hon'ble Minister for Environment and Forests Shri Nabum Tuki inaugurated the workshop and it was addressed by many senior forest officers and subject experts. Altogether 30 forest officers including DFOs, ACFs and Range Officers from various parts of Arunachal Pradesh took part in the training. Experts from NERIST, GBPIHED, NEHU apart from Scientists of SFRI, gave technical inputs in the workshop.

IFS ASSOCIATION NEWSLETTER - ARUNARANYA RELEASED.

The first of the quarterly newsletter of the IFS Association, Arunachal Unit, was formally released. The newsletter contains not only information on the forest officers but also on recent events pertaining to forest and forestry sector of the state. Needless to say this newsletter will facilitate exchange of views, information and sharing of experience and knowledge among foresters of the state as well as the country, and benefit growth of forestry sector in the state.

TRAINING IN BAMBOO PROPAGATION TECHNIQUE.

The Division of Forest Genetics, State Forest Research Institute, Itanagar conducted one day training programmes on 17.11.2000 and 30.11.2000 at Naharlagun and Banderdewa nurseries in association with Social Forestry Division, Itanagar and Banderdewa Forest Division, Banderdewa, respectively. The objective of the programme has been to transfer the technology of mass-propagation of bamboo through vegetative means, to the field staff of the forest department and local farmers. In this training various techniques of propagation of bamboos in the nursery were demonstrated. A field manual on bamboo propagation brought out by the SFRI was also distributed to each of the participants. The programmes were attended by 11 field staff of Social Forestry Division, Itanagar and more than 60 participants at Banderdewa Division. Considering the importance of bamboos in Arunachal Pradesh, similar programmes have also been planned at Foresters Training School, Roing and other Forest Divisions of the state in the near future.

EXHIBITION OF NON-TIMBER FOREST PRODUCTS.

On the eve of completion of one year of Shri Mukut Mithi's Arunachal Government, an exhibition of achievements by various departments were organised at Indira Gandhi Park on 11th October 2000. On that occasion, Department of Environment and Forest displayed the products of Arunachal Pradesh, depicting the potentials of medicinal plants, Bamboo, canes, orchids and other minor forest produces. Smt. Sonia Gandhi, Opposition Leader, and President Indian National Congress inaugurated the exhibition. She evinced lot of interest in medicinal and aromatic plants and other minor forest produces. The exhibition stall was also visited by Hon'ble Chief Minister, Mukut Mithi, and his cabinet colleagues, many VIPs, dignitaries and general public.

TIGER POPULATION INCREASED IN NAMDAPHA

A census conducted in Namdapha Tiger project in December 1999 has shown an increase in population with 60 numbers of tiger as against 57 recorded during December 1997. The biannual census has shown an increase in the tiger population which is a positive sign as appraised by the management of the Namdapha tiger project.

INTERNATIONAL TRAINING ON BAMBOO.

Dr. K. Haridasan, Systematic Botanist, State Forest Research Institute attended an international training course on Sustainable Bamboo Management and Processing Techniques for Small-Size Bamboo Enterprises in China jointly organised by Ministry of Science and Technology of China (MOST), International Network for Bamboo and Rattan (INBAR), International Farm Forestry Training Centre, Chinese Academy of Forestry (INFORTRACE) during Oct 4-16, 2000. During the training he has visited some of the bamboo growing areas like Lin'an, Anji, Dequing, Fenghua and Xinchang. The trainees are exposed to various technologies in cultivation and management of plantations and germplasm banks during their field work. Altogether 18 different factories producing a number of bamboo products and machinery for bamboo industry were also visited. During the visit Dr. Haridasan had also chance to interact with Scientists from different bamboo growing countries from all over the world mainly Asia, Latin America and Africa. He presented a paper entitled, "Bamboos in the flora of North East India" in the workshop. After the workshop he could visit INBAR at Beijing and got literature and information pertaining to bamboo (see related article in this volume). Fund support for his visit was extended by UNIDO.

FOREST MINISTER VISITS SOUTH EAST ASIA

A four member delegation led by Minister for Environment & Forests, Shri Nabam Tuki visited Malaysia, Singapore and Indonesia from December 20 to 28, 2000.

The other members of the delegation were Shri Nakul Chai, Minister of State for Environment and Forests, Dr. Rabindra Kumar, IFS, D.C.F. (HQ) & Joint Secretary (E & F) and Shri Tapu Gapak, SFS, Divisional Forest Officer, Hapoli Forest Division. During the nine-day tour, the delegation visited Kuala Lumpur, Kepong, Singapore City, Jakarta and Bogor. The objective of the study tour was to have an overview of forestry activities in the developing South East Asian countries where tropical forests are being managed with advanced technologies with a view to sustainable use of timber and non-timber forest products (NTFPs). In order to conceptualize appropriate project proposals, it was considered worthwhile to have an exposure to various research activities and forestry related projects with multi-disciplinary approach in the countries like Malaysia and Indonesia. In these countries, the activities of Department of Environment and Forests are diversified through micro planning processes towards attaining the goal of people's participation in management of their natural resources.

The delegation visited Forest Research Institute Malaysia (F.R.I.M) Kepong, Directorate of Wild Fauna and Flora Conservation, Jakarta Pusat, Botanical Garden, Sea World, Jakarta and various plantations and research and development activities in the field of Tropical Forestry, Environmental Conservation and Pollution Control in the above countries.

The delegation met and held discussion with the Directors and the Scientists of F.R.I.M. with regard to their various activities in the management of forests which were observed to be quite systematic and well managed. The programmes for environmental awareness through education and extension were also found to be very effective and impressive.

SFRI DEVELOPS FOUR MORE NEW ORCHID HYBRIDS

Orchid division of the State Forest Research Institute has developed four new orchid hybrids- three intergeneric and one interspecific. They are.

Arachnocentron - *Arachnis labrosa* X *Cleisocentron trichromum*
Ascocenda - *Ascocenda Peggy Foo* X *Vanda coerulescense*
Esmeranda - *Vanda stangeana* X *Esmeralda clarkei*
Cymbidium -*Cymbidium Stanley Fouraker var. Arcadia* X *Cymbidium hookerianum*

Considerable efforts have gone in evolving these hybrids over the last 15-16 years by the team of scientists for studying, observing and field trials and now being communicated for registration with suitable names as per the International rules for registration of orchid hybrids under the Royal Horticultural Society, London. Further, under the DBT sponsored project "Micropropagation and *in vitro* induction of polyploidy in some commercially important vandaceous orchids of Arunachal Pradesh". 14 mutants have been detected in addition to five unnamed mutants of beneficial traits of vandaceous orchids namely. *Aerides rosea, Renanthera imschootiana, Vanda parishii, Vanda stangeana, Renades Arunadoya,* and a hybrid of *Aerides odoratum* and *Vanda stangeana*. It is significant to note that under the breeding and plant improvement programme micropropagation protocols for seeds, axilliary buds, leaf, root tips, nodes and internodes of inflorescence explants of these selected orchids have been standardised as an alternative source of meristematic tissue for mass propagation.

SFRI PROMOTES FOUR CYMBIDIUM ORCHID FARMS

Under the extension support fund project of Indian Council of Forestry Research and Education (ICFRE), the SFRI, Itanagar has promoted the development of four Cymbidium farms by promoting four Orchid Societies as beneficiaries. These farms are situated at Hapoli, Joram (Yazali), Bomdilla and Dirrang and respectively owned by Abotani Women Orchid Society, Hapoli, Oju Welfare Association, Naharlagun, Lhayul Agri-horti-floriculture Society, Bomdilla and Dirrang Floriculture Society, Dirrang. All the members of these societies have been imparted training, supplied with seedlings, and implements and equipments to establish these four orchid farms. These farms are expected to start yielding the cut-flower products from 2002 onwards and expected to create an awareness amongst the local entrepreneurs and farmers on orchid farming. They would also act as nodal agencies for the development of orchid farming in their respective localities thereby establishing an ecofriendly economic activity in the floriculture sector.

DISTINGUISHED VISITORS TO SFRI

(1) 09-02-2000 : Prof. K.S. Bawa, University of Massachusetts, USA.
(2) 11.02.2000 : His Excellency the Governor of Arunachal Pradesh Shri Arvind Dave accompanied by Madam Smt. Meenakshi Dave

(3) 22.02.2000 : Madam Flora McDonald. former IRDC- Chairperson and former Dy. Prime Minister of Canada alongwith Shri Daniel Taylor Ide of Future Generations, USA.

(4) 24.02.2000 : Hon'ble Minister of Environment & Forests Shri Nabum Tuki

(5) 17.03.2000 : Hon'ble Chief Minister Shri Mukut Mithi

(6) 17.03.2000 : Planning Commission Chief Advisor, Govt. of India

(7) 24.04.2000 : Scientists from KFRI

(8) 10.05.2000: Dr. Chakraborty, Indira Gandhi Manav Sangrahalay, Bhopal alongwith Shri S. Chatterjee, WWF-India, New Delhi.

(9) 17.08.2000: Justice Naresh Chandra Jain, Judge, Guwahati High Court, Guwahati.

(10) 13.10.2000: Smt. Somi Tandon, Adviser (NE), Planning Commission, GOI, New Delhi, accompanied by Shri. P.M. Nair, Chief Secretary, Government of Arunachal Pradesh.

(11) 13.11.2000. a) Govindas Konthoujam, Minister Power, Manipur. b) Shri H.N. Goswami, Minister Power, Assam.

(12) 14.11.2000. Shri K. Thangzualla, Minister Power, Mizoram.

S.F.R.I. Publications

Information Bulletins :

1. Jhum Cultivation in Arunachal Pradesh.
2. Alder – a Promising Tree for Afforestation of Jhum Fallows
3. Botanical and Vernacular names of Important and Common Forest Plants of Arunachal Pradesh
4. Pipli – an Important Income Generating Eco-friendly Non-wood Forest Products.
5. Medicinal Plants of Arunachal Pradesh
6. Seed Technology
7. Broom Grass
8. Micropropagation and Farming of Cymbidium Orchids as Supplemented Crop in Jhum/ Waste Lands of Arunachal Pradesh
9. Nursery techniques of local tree species
10. Toko (a multipurpose palm tree)
11. Cymbidiums : Cultivation technique and trade.

Books : Orchids of Arunachal Pradesh – by Dr. S. N. Hegde

CAPTIONS TO

Third Cover :

Top - Left to right : Scientist (FRIM; Mr. Jaffar, PRO (FRIM); Mr. T. Gapak, DFO (Hapoli); Mr. Abdul Rahim Nik, Director, Techno-Economics Divn. (FRIM); Mr. Nabam Tuki, Minister (Env. & Forests); Mr. Nakul Chai, MOS (E & F); Dr. Rabindra Kumar, D.C.F. (HQ) & Joint Secretary (Env. & Forests) After a meeting in Board room, FRIM, Kepong.

Middle - Non Dipterocarp Arboretum, F.R.I.M.

Bottom - Botanical Garden, Directorate of Wild Flora & Fauna Conservation, Jakarta, Pusat. — Photos by Rabindrakumar

Back Cover: Bamboo utilization in North East India

1. Top Left – A tribal dwelling house made up of bamboos 2. Top Right – Bamboos in basketry 3. Centre Left. – Bamboo Crafts – a lantern 4. Centre Right .- Baskets for tea gardens 5. Bottom Left – Bamboo tea cups 6. Bottom Right – A bamboo comb. — Photos by B. B. Bhat and N. S. Bisht

Front Cover Photo by : Dr. K. Haridasan.

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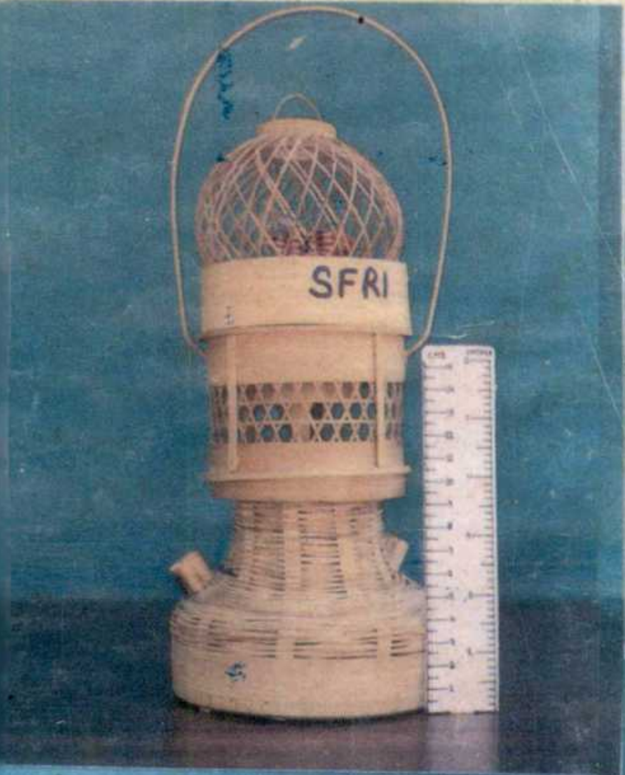
NON
DIPTEROCARP
arboretum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